

# THE SCIENTIFIC MONTHLY

EDITED BY J. McKEEN CATTELL

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The author's contention is in accord with Bergson's Philosophy as to the limitations of the human intellect.

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# THE SCIENTIFIC MONTHLY

APRIL, 1916

## PROBLEMS ASSOCIATED WITH THE STUDY OF CORAL REEFS<sup>1</sup>

BY PROFESSOR W. M. DAVIS  
HARVARD UNIVERSITY

*The Visible Features of Coral Reefs.*—One of the most striking features of coral reefs is their incapacity to reveal the conditions of their origin. True, the observer on a reef, whether he is a zoologist or not, may see the extraordinary luxuriance of coral growth, and may discover that the heavier forms grow under the surf on the outer slope, while the more delicately branching forms frequent the quieter waters of the lagoon. The variety of pattern and the delicacy of coloring, as seen in the clear and quiet lagoon waters, are endlessly entertaining; but it is



FIG. 1. FRINGING REEF, SOUTHEAST END OF NEW CALEDONIA; LOW TIDE. This is the inner part of the reef flat shown in Fig. 2. The slender trees on the headland are the New Caledonian araucaria, or pine.

exceptional for them to be laid bare at low tide over broad surfaces, as they are in the Great Barrier reef of Australia, so wonderfully pictured in Saville Kent's notable volume. Hence unless the traveller is fore-

<sup>1</sup> Presented at the Washington meeting of the National Academy of Sciences, April 20, 1915.

warned he will be disappointed in the dull gray coral rock that prevails over the greater part of the reef flat, Figs. 1 and 2, strewn with scraps of dead coral, and holding living forms only in its little pools—occasional small corals, large dark-blue starfish, sea urchins with a small number of heavy brown spines or with a larger number of long hat-pin-like black spines, giant clams with many colored mantles lining their slightly open valves, and various kinds of calcareous algæ. He will often see large masses of coral, sometimes ten or fifteen feet in diameter, that have been torn by waves, Fig 2, from the outer face of the reef, now scattered over the reef flat, suffering slow disintegration as they are battered by later storms and shifted across the flat toward the lagoon; and in the



FIG. 2. REEF FLAT, SOUTHEAST END OF NEW CALEDONIA; LOW TIDE.

lagoon he will find patches of growing corals surrounded by white coral sand or gray silt that is swept from the reef flat.

If he be a zoologist, he will revel in the opportunity of study in so superb a natural aquarium; he can there find the coral larvæ to be free-floating forms of pin-head size that are carried far and wide by ocean currents—some of them to add to the population of existing reefs, most of them to die in deep water, and a few to arrive by lucky chance on a reef-free coast, where they may establish themselves, if the temperature be high enough, and in time form a new reef close along the shore, known as a fringing reef. With wider experience, supplemented by sounding and dredging, the observer will learn that reef-building corals do not grow in turbid water, or at greater depths than 20 or 30 fathoms, or in latitudes where the winter temperature of the water is lower than 20° C. He may by wandering on many reefs gain acquaintance with

their various forms—fringing reefs, close along shore, as already mentioned; barrier or encircling reefs, Figs. 3 and 4, separated from their



FIG. 3. BARRIER REEF, NARROW LAGOON, AND EMBAYMENT, NORTH SIDE OF NGAU, FIJI. In the mid-foreground a branch valley descends to a small delta on the side of the main-valley embayment.

mountainous central island by a shallow lagoon half a mile or several miles in width; or atolls, precisely like barrier reefs, except that their lagoon has no central island; and he may, by imagination, gain appre-



FIG. 4. SURF ON THE BARRIER REEF OF RAIATEA, SOCIETY ISLANDS; HALF TIDE.

ciation of the secondary and larger meaning of the term, coral reef; for, as employed by Darwin, Jukes, and others, it means not only the visible structure at sea level, but also the whole calcareous undermass that has been added in bench-like form around its foundation; of small volume in narrow fringing reefs, probably of enormous volume in large atolls.

During these entertaining wanderings and reflections the observer may consciously, yes, insistently, review the various theories by which the origin of coral reefs has been explained. But so long as he confines his attention to the sea-level reefs, he will not be able to make sure which one of the eight or nine competing theories is the right one: for sea-level coral reefs reveal only their existence in the present, not their origin in the past. Apart from indications as to limiting depths and temperatures, as just stated, the visible reefs give no conclusive testimony as to the conditions and processes of their past formation. It is probably for this reason that so many contradictory, mutually irreconcilable hypotheses concerning the mode of reef formation have been invented. There was, to be sure, a period from 1840 to 1870 when Darwin's theory of upgrowth during intermittent subsidence, gained universal acceptance; for it completely superseded a few earlier theories and for a long time had no competitors. But after undisputed success for a generation, several rival hypotheses were brought forward, and then for some thirty years the universal agreement previously prevailing was succeeded by many and wide differences of opinion. The truth of the matter is that, during this period, the coral-reef problem has been encumbered by the rivalry of several immature, imperfectly argued, and really incompetent hypotheses, whereby progress has been embarrassed if not hindered. But during the past thirteen years several Australasian students of coral reefs in the Pacific, and for a shorter period a few students in the Atlantic, have been finding evidence that has led them to set aside the newer unsatisfactory views and return to or towards Darwin's theory. Such was the condition of things, when, aided by a liberal grant from the Shaler Memorial Fund of Harvard University and by a generous subsidy from the British Association for the Advancement of Science, which carried with it an invitation to attend the colonial meeting in Australia, I was enabled to spend the greater part of the year 1914 in visiting a number of reef-encircled islands in the Pacific ocean, for the purpose of examining on the ground as carefully as possible the merits of the various theories that have been brought forward in explanation of these extraordinary structures.

*Theories of Coral Reefs.*—Before starting on this journey, I made a preparatory review of the rival hypotheses,<sup>2</sup> in which I was aided by several references supplied by Dr. T. W. Vaughan, of Washington, whose

<sup>2</sup> The Home Study of Coral Reefs, *Bull. Amer. Geogr. Soc.*, XLVI., 1914, 561-577, 641-654, 721-739.

studies of Atlantic reefs began some years before mine were undertaken on the Pacific. In this review especial attention was given to the critical tests by which the success of the several theories could be measured, and the review confirmed me in the belief that Darwin's original theory, invented, as he tells us, before he had ever seen a true coral reef, is by far the most successful of all. I say "confirmed in the belief," because earlier still, I had prepared a diagram to set forth the special merits of Darwin's theory, as they were then understood: indeed twelve years ago my opinion favoring Darwin's views was briefly stated in a small text-book; but, it is regrettable to add, such was the weight of authoritative counter statements that my belief in Darwin's theory was for a time weakened; yet it was soon strengthened again when making the preparatory review over a year ago. This must be made plain, so that any one may estimate for himself whether, in what is now to follow, my presentation of the case is prejudiced, and particularly whether I am guilty of that grievous error known as "special pleading"—arguing in favor of some favorite theory—instead of giving impartial consideration to all. My preference would be to make an impersonal, objective presentation of the problem; but inasmuch as a number of different theories must be examined, some attention must be given to the experience, the qualifications and the methods of their inventors; thus the discussion inevitably becomes somewhat personal. One of the most interesting results of the preliminary inquiry of a year ago was that an investigation of the coral-reef problem inevitably leads far away from the direct study of corals and coral reefs, and enters upon the discussion of many other problems which at first might seem to have no relation to it: it is for that reason I have entitled this address: "Problems associated with the Study of Coral Reefs."

*Methods of Investigation.*—Now if coral reefs themselves are so uncommunicative as to their past history, the search for their origin—whether they are fringing reefs, close alongside of an island or a continental shoreline, or barrier reefs, separated from the shore by a shallow lagoon, or atolls standing alone in the ocean—can not be successfully prosecuted until the fundamental problem of how to conduct a scientific investigation of this kind has been duly considered. Let me therefore state briefly that the method of investigation which is here selected—it is more fully set forth in the preparatory review above referred to—demands, first, the observation of pertinent facts and the review of published observations by others: then, spurred on by the spirit of wondering inquiry and aided by related knowledge, it appeals to speculation, imagination and invention, or borrows from the speculation, imagination and invention of others, in the hope of thus coming upon the mental concepts or "hypotheses" of all the possible ways in which reefs could ever have been formed; and when this has been done the investigator arrives at the ponderous question: Which one of all these hypoth-

eses is right? He might at first answer this question by saying: Visit the reefs themselves with the various theories in mind, and see which one best accounts for the facts there observable; but if this advice is literally followed, no satisfactory result is obtained from it, for the reefs are so complacently indifferent that they make no objection to any one of the eight or nine theories that have been proposed to account for them. Of course they make no objection, for no theory would get so far as being announced if it did not at least explain the visible facts of the



FIG. 5. ACROSS FAAROA BAY, EAST SIDE OF RAIATEA, SOCIETY ISLANDS.

reefs that it was invented to explain! A really successful theory must do much more than that: it must, in Chamberlin's phrase, explain various things that it was not invented to explain; for example, facts that were not thought to be connected with reefs, or facts that were not known when it was invented.

In order to see if a theory can stand this added test, its consequences must be logically deduced from the postulated premises and impartially confronted with the the appropriate facts. Confrontation as well as deduction demand concentration of attention on the problem in hand, and the exclusion as far as possible of all distractions, such as the remote and picturesque reef-encircled islands afford in abundance. If the confrontation is successful, the theory is good; if unsuccessful, the theory is erroneous. But why should a truism like this be stated in these modern years! Because; surprisingly enough, a review of the published studies of the coral-reef problem leads to the conclusion that, with a few distinguished exceptions and those chiefly in the works of Darwin and Dana or their followers, the methods employed have been incomplete, illogical and untrustworthy, and the results reached are therefore unconvincing.

*Outgrowing Reefs on Still-standing Islands.*—For example, several observers thirty-five or forty years ago came to believe that reefs are formed by outgrowth on their advancing talus around still-standing foundations. One of these observers was a zoologist of limited experience with coral reefs in the Atlantic; another, also a zoologist, had a more extended experience with coral reefs in the Pacific, but seems to have been little informed in physical geology; a third was a distinguished explorer of the oceans, who early in his scientific career came independently on this still-stand theory, as it may be called, which has become known chiefly through his vigorous advocacy of it. In an article which gave more attention to another scheme, here considered on a later page under the name of the "up- and outgrowth theory," he briefly stated his simpler theory substantially as follows:

The still-stand theory supposes that coral reefs, once established by colonizing larvæ as fringing reefs on a suitable foundation such as the shore of a young volcanic island, have been enlarged by outward growth on the advancing talus of their own detritus, the still-standing island suffering no change in attitude with respect to sea level while it is slowly worn down lower and lower as the reef grows outward; at the same time the inner part of the reef is dissolved away and converted into a shallow lagoon, so that the initial fringing reef is in time developed into a barrier reef. Finally the central island may be completely worn away, leaving an uninterrupted central lagoon, so that the barrier reef becomes an atoll. The "distinguishing feature" of this theory, as described by its inventor, is that, in conjunction with the associated theory of up- and outgrowth, by which atolls may be built up on submarine volcanoes crowned with an "organic rain" of calcareous deposits here to be discussed later, it does away with "the great and general subsidences" involved in Darwin's theory. He concluded:

If it has been shown that atoll and barrier reefs can be formed without subsidence, then it is most unlikely that their presence in any way indicates regions of the earth's surface where there have been wide, general and slow depressions.

But why should one possibility exclude another! It is apparently true, as an abstract proposition, that coral reefs may be formed by outgrowth around still-standing islands, as this oceanographer had suggested; but a geologist asks not merely by what processes coral reefs may have been formed, but how they really have been formed. Yet because coral reefs may have been formed in a certain way, the scientific world was urged to believe that they have been formed in that way; indeed, the third inventor of this still-stand theory later rejected the possibility of reefs being formed by upgrowth during subsidence, and regarded his possible scheme of outgrowth on a still-standing foundation as the equivalent of actual processes, for he eventually said:

It seems impossible with our present knowledge to admit that atolls or barrier reefs have ever been developed after the manner indicated by Mr. Darwin's simple and beautiful theory of coral reefs.

*Consequences of the Still-stand Theory.*—What procedure should be followed with respect to the still-stand hypothesis by an unprejudiced inquirer? Evidently he should ask: What are all the deducible consequences of the hypothesis; which ones of these consequences can be confronted with the observable facts of to-day; and particularly which ones of the confrontable consequences are unlike the corresponding confrontable consequences of competing hypotheses. These steps are indispensable in any well ordered investigation into the past origin of existing features; and they are particularly desirable here, because they were almost wholly neglected in the statement of the theory by its leading advocate. For example, so important an element of the theory as the wearing away of the central island was very briefly treated, chiefly in a single sentence:

In the case of the atoll the cone may have been reduced below the level of the sea by the waves and atmospheric influences.

So summary a disposition of the matter is insufficient. The successive stages of this long process must be reasoned out; otherwise the theory can not be thoroughly tested. The successive stages of change must, indeed, be reasoned out with equal care and fairness for every alternative scheme, for only thereby can the investigator guard himself against becoming unwarrantably fond of some special hypothesis. He must make an effort consciously to deduce all the consequences of each hypothesis, lest an important consequence remain overlooked. He must then select those consequences which may correspond to existing facts; the others can not be used in testing the hypothesis from which they follow. And he must give special attention to those consequences of each hypothesis which contradict corresponding consequences of the rival hypotheses, because it is only in this way that crucial tests can be found which select a certain hypothesis as the successful one, and point out the others as incompetent. There is nothing whatever new about all this; the only surprising thing is that the method has not been consistently applied instead of, as a rule, unconsciously neglected in coral-reef studies.

It has been noted above that, in following the procedure thus indicated, we must often turn from coral reefs and consider various associated problems. In the case before us, we must consider the changes that a still-standing oceanic island will, while the reef is growing outward around it, suffer under the attack of subaerial erosional forces which wear its initial form down lower and lower as the reef grows larger and larger and the lagoon becomes wider and wider, till after the island reaches the form of a penultimate lowland, it is consumed by the waves

—not however by the heavy waves of the deep and open ocean, but by the moderate waves of the shallow and enclosed lagoon. To illustrate this we may assume that a young volcanic island of simple conical form and roughly circular rim is built up by eruption from the ocean bottom, and that a narrow fringing reef is established on its shore, as in sector *G* on the left side of Fig. 6. As the reef grows outward, sector *H*, on its advancing talus and a lagoon is more or less completely dissolved out behind it, the bottom of the lagoon should consist of ragged, dissolving limestone, or of insoluble residue. At the same time the central island suffers erosion; radiating valleys are excavated in its slopes and deltas are formed in the shallow lagoon, or on the inner part of the reef if it be not already dissolved away. Reefs thus formed should tend to become broad and continuous, with marks of outward growth in the form of

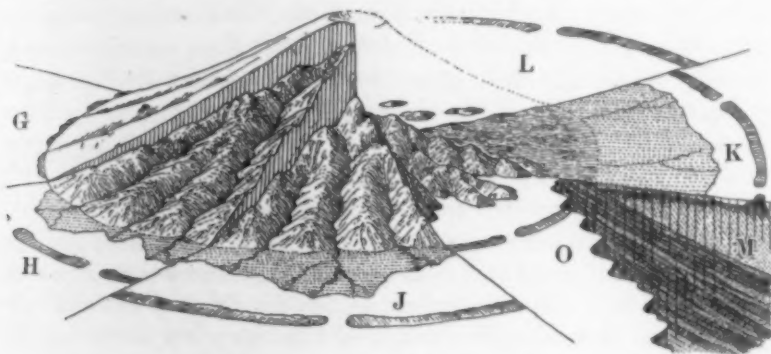


FIG. 6. DIAGRAM OF SUCCESSIVE STAGES OF REEF FORMATION, as deduced from the theory of outgrowing reefs on still-standing islands: sector *O*, type of actual barrier reef and its embayed central island.

prograded beach ridges; islands of coral sands should be built by the waves on the reef flats and soon become covered with vegetation. The process continues, as in sector *J*, where the volcano is much reduced in altitude while the deltas have been built forward to greater size and have become laterally confluent; and later in sector *K*, where the island is reduced to a lowland surrounded by a broad alluvial plain just above sea level; the structure of the reef is here shown in a vertical section *M*, on the side of sector *K*; the submarine talus layers must slant into deeper and deeper water at a steeper angle than the slope of the volcanic cone, the buried surface of which is not eroded, for by the conditions of the hypothesis that part of the cone has never been above sea level to suffer the attack of eroding agencies. At last in sector *L*, the lagoon waters are supposed, in a manner not clearly stated in the original account of this hypothesis, to have removed not only the alluvial delta plain but the central volcanic lowland also, except perhaps for some low residual hills; when they vanish the reef must be called an atoll; not that the

reef itself has in any way changed its nature, but that the lagoon is then uninterrupted with a depth of 10, 20 or 30 fathoms.

*Confrontation of Still-Stand Consequences with Facts.*—Now this is all, with the possible exception of the excavation of the atoll lagoon 20 or more fathoms deep across the volcanic lowland, easily conceivable; it may have happened, but how can we tell if it really has happened; how can we know that the hypothetical scheme, here represented graphically, truly corresponds to the history of any actual coral reefs? Only by confronting the deduced consequences of the hypothesis with the appropriate facts of observation. There is absolutely no other logical method of procedure in the coral-reef problem or in any similar problem. Where then shall we look for the appropriate facts with which the deduced consequences are to be confronted? First, in young, little dissected volcanic islands around which discontinuous fringing reefs form a narrow and incomplete girdle. Such islands are occasionally found, and thus give observational warrant for the initial conditions postulated in the still-stand hypothesis: but, as the same initial conditions are postulated in certain other hypotheses, no critical test for the correctness of the still-stand hypothesis is thus secured. We must look next at sea-level reefs of the barrier or atoll class: they confirm the possible correctness of the hypothesis, because the deduced features of barrier and atoll reefs are essentially the same as the visible features of the actual reefs—of course they are, for these sea-level reefs are the very facts which the still-stand hypothesis was invented to explain; and, if it had not explained them, it would never have been published. But the difficulty here is, that all the other hypotheses do exactly as well: they also explain the barrier and atoll reefs that they were made to explain; hence no crucial test is yet provided by means of which a choice among the competing hypotheses may be made.

What do the observable features of a lagoon within a barrier reef or atoll say, when the expected features of a lagoon as deduced from the still-stand hypothesis are confronted with them? As far as actual lagoons have been studied they contradict the idea of excavation by solution or otherwise, for they seem to be the seat of sedimentation; the sediments being supplied either by calcareous overwash from the reef, by organic deposits formed within the lagoon itself, or by outwash from the island streams. But it is to the form of the central island within a barrier reef, or to the internal structure of an elevated reef that we must give special attention, for there the consequences deduced from the hypothesis include several details that had not been observed or thought of when the hypothesis was invented; and it is the unforeseen consequences of a theory that are of special importance in testing its value. Of these two witnesses, the central island gives the most outspoken and unimpeachable testimony. Hence to the central islands of barrier reefs we will for the moment attend.

*The Central Islands of Barrier Reefs.*—The question now before us is: Are the features of an imagined central island, as deduced from the hypothesis here under consideration, successful counterparts of actual central islands? No, they are decidedly unsuccessful. The central islands of various barrier reefs, such as Ka-ndá-vu, Fig. 23, in the Fiji group—one of the thirty or more reef-encircled islands that I saw in 1914 in the Pacific—and various other central islands that were then seen or that have been studied before and since on large-scale charts, contradict the deduced features of the hypothetical still-standing islands in certain essential particulars. A common type of actual island is shown in sector *O*, of Fig. 6; its base line is not simple, as in sectors *G* to *K*, but elaborately embayed; and the large confluent deltas that should advance outside the simple margin of a well-dissected island, as in sector *J*, are represented only by small, separate deltas at the heads of bays and coves. Darwin long ago recognized that, in the embayed island of Vanikoro, which sector *O* represents sufficiently well, "the unusual depth of the channel [lagoon] between the shore and the reef . . . and the small quantity of low alluvial land at the foot of the mountains, all seem to show that this island has not remained long at its present level." Furthermore, inasmuch as the Pacific contains many barrier-reef islands and many more atolls, we ought, if the hypothesis under consideration be correct, to find also a good number of worn-down islands in the intermediate stage of sector *K*; but not a single example of such an island has been discovered. Again, the almost-atoll stage of sector *L* shows the small residual volcanic hills to be of low and subdued form; yet the actual form of residual volcanic hills which occupy only a small fraction of their lagoon, resembles the summits of the dissected volcano shown in sector *O*. Finally, not a single example of many elevated reefs and atolls has been described as consisting wholly of the slanting talus structure demanded by this hypothesis, as shown in section at *M*, Fig. 6. Hence, although the hypothesis explains the facts regarding the sea-level reefs that it was made to explain, it fails to explain certain other equally essential facts, and it must therefore be rejected.

*What commended the Still-Stand Theory?*—Thus we are led back to the conclusion that Darwin reached long ago, for in his book on "Coral Reefs," published in 1842, he considered the possibility of outgrowing reefs around still-standing islands, and, as the quotation given above shows, wisely rejected it, because the consequences to which it led were not supported by the facts. Yet in the recent history of the coral-reef problem this crude hypothesis, instead of being rejected by every one, has been cordially received by a number of eminent geologists. What can have commended it? Did its chief advocate carefully discuss various alternative hypotheses and show them to be insufficient? He may have done so privately, but he published no such discussion. Did he discuss his own theory by analyzing the associated problems and de-

ducing their consequences in systematic fashion, in order to confront the consequences with the facts and thus reach an impartial judgment? It is of course possible that he may have done so, but his published articles do not suggest that he did. Is the fundamental postulate of a still-standing island a sound one? No, for practically every oceanic island of which the history has been worked out in detail is found to have suffered some sort of change of attitude with respect to sea-level: hence the postulate of a still-standing island is probably incorrect. Can it be, perhaps, that the advocate of the still-standing hypothesis was so fully experienced in the study of coral reefs and of volcanic islands that his opinions were thereby well recommended? If we judge by the favorable consideration that has been so widely given to his hypothesis, this would appear to be the case; but alas, it was not. The advocate had been, before announcing the hypothesis, a member of an exploring expedition, which had truly enough visited several volcanic and coral islands in the Pacific and the Atlantic, but the official narrative of the expedition states that the study of coral reefs was not within its scope; hence we must suppose that the coral-reef problem was not closely attended to during the voyage.

*Neglect of Essential Factors.*—Nor could the literature of the coral-reef problem have been closely examined by the advocate of the still-stand theory either before or after the voyage, although the scientific world has a right to expect that it should be so examined by anyone who, discarding a generally accepted theory, proposes to replace it by a new hypothesis. Had such an examination been made, an important factor of the problem—Dana's principle of shore-line development—would have been found, clearly announced by a competent investigator and published thirty years earlier; and this factor would have prevented the acceptance of the new theory and reestablished confidence in the older theory. Indeed, if this factor had not been overlooked, the embayments of certain Pacific islands would probably have been correctly instead of incorrectly interpreted by the advocate of the still-stand theory; and he would thereby have been saved from presenting, in the report of the expedition to which he was attached, an erroneous account of the maturely dissected, reef-encircled volcanic island of Matuku, in the Fiji group, where a drowned-valley embayment on its western side is described as a crater. Had the neighboring ring-shaped volcanic island of Totoya been visited, instead of Matuku, a crater, or rather a huge caldera, of volcanic origin would truly have been found, and such a caldera does not of itself testify against still-stand, for it may have been formed by explosion or by engulfment either below or above sea-level; but to mistake the embayment of Matuku for a crater is very much as if a traveller unacquainted with the effects of tornadoes on village architecture should, on following a storm track to a ruined dwelling house, mistake its dilapidated cellar, half-filled with rain water, for its vanished attic. The chief embayment of Matuku is, like

the many smaller ones, really a valley of erosion, deeply carved below any crater that may once have existed aloft, now half drowned by subsidence and therefore occupied by sea water. Three summits rise over 1,200 feet above the bay, about two miles distant on the northeast, east, and southeast; a sounding, about as far to the west of the bay as the three summits stand on the other side, shows a depth of 400 fathoms; two miles farther west the depth is 975 fathoms.

A few pages farther on the report of the same exploring expedition announces a recent and slight elevation of a few feet in the wonderfully embayed Fiji island of Ka-ndá-vu, but says not a word of the evidence of vastly greater previous subsidence that an island of such pattern loudly proclaims. Evidently then, the problem of the sculpture of volcanic islands and the origin of their shorelines, closely associated as it is with the problem of coral reefs, had not been solved, nay, had not even been seriously studied by the advocate of the hypothesis that barrier reefs and atolls may be formed by outgrowing corals, advancing on their own talus around still-standing islands, while the lagoon is etched out by solution and the island is worn down by erosion behind them. No wonder, therefore, that his incompetent hypothesis satisfied him.

*An Exceptional Island.*—Is there then nothing to be said for the still-standing scheme? Yes, the island of Tahiti in the Society group has been instanced as supporting this hypothesis, for it has salient and imperfectly confluent deltas inside of its barrier reef, as the hypothesis of a still-standing island demands; but Darwin long ago recognized that such salient deltas are exceptions on barrier-reef islands, and correctly explained them as marking, not a perpetual still-stand, but a pause in subsidence. He said: "At the Society archipelago . . . the shoalness of the lagoon channels round some of the islands, the number of islets formed on the reefs of other, and the broad belt of lowland at the foot of the mountains, indicate that, although there must have been great subsidence to have produced the barrier-reefs, there has since elapsed a long stationary period"; and he adds: "This probably is the ordinary course of events, subsidence supervening after long intervals of rest." He was right, for the heads of the projecting deltas at Tahiti, Fig. 12, commonly enter a mile or more into the radial valleys back of the spur ends, precisely as they should if the island had been somewhat depressed after it was dissected, and had stood still for a time after it was depressed.

*Why Was the Still-Stand Theory Accepted?*—Why, then, if the hypothesis of outgrowing reefs around still-standing islands really has so little recommendation, did it ever gain so much attention? Partly, I think, because, although very briefly announced, it was stated with confident emphasis instead of with critical analysis; for confidence and emphasis go, even in science, a great way; partly also because no mention was made of certain critical facts, namely, the embayed shore-

lines of the central islands with small deltas at the bay heads, which contradict certain essential consequences of the theory, namely, non-embayed shorelines with large outstanding deltas. The readers of the article which contained this "totally new departure in coral-reef literature," as an able critic wrote, seem to have accepted it as a complete statement of the case, from which no essential facts were omitted. Indeed one of the most competent of them, everywhere recognized as a leader in geological science, championed it by saying: "We are driven to admit that barrier reefs may be formed without subsidence of the sea floor." Thus the hypothesis of outgrowing reefs around still-standing islands—a hypothesis that involves the extremely improbable fundamental postulate that oceanic islands usually stand still, a hypothesis that was constructed on an inadequate basis of incomplete observation, a hypothesis that was framed without careful study of the literature of coral reefs, a hypothesis from which all consideration of an important associated problem was omitted and from which certain essential consequences could not, therefore, be critically deduced—was announced with confident emphasis and championed with authoritative recommendation; and, as a result this incompetent hypothesis has been, especially with regard to barrier-reefs, a bar to progress for thirty years; not because it was invented, but because it was announced and accepted without sufficient study of associated problems, by means of which alone its competence could be determined.

Let me here explain briefly why so much time has been given to the consideration of an incompetent hypothesis. First, because it has been accepted by many home-students of the coral-reef problem; on that ground rather than on its merits it deserves attentive consideration. Second, because it is the duty of any investigator of a problem such as we are now discussing to examine on his own responsibility every hypothesis that has been put forward to explain it; and because it is particularly his duty to search out all the points where he has to differ from others who, just as earnestly as himself, have been striving for the truth. Finally, because it is part of his task to learn if possible the grounds which led to the acceptance by others of what is to him unacceptable. Under the actual conditions of the case thirty years ago, it was perhaps not unnatural that many home-students of coral reefs should have accepted the still-stand hypothesis; for its advocate was a man of great experience in oceanographic work, of inspiring enthusiasm, and of delightful personality; and its leading champion was a man of exceptional competence in all branches of geological science and of unusual skill in the presentation of geological problems. More important still, both of these investigators frankly avowed that they had adopted the new still-stand hypothesis because it seemed more successful in explaining coral reefs than Darwin's hypothesis of subsidence which they had previously regarded as correct, but which they had come to regard as unsuccessful. Both of them were genuinely and

sincerely devoted to scientific research; hence how could any one, who had not the time to investigate for himself the question at issue, hesitate to accept the conclusion of these two eminent experts!

It was therefore, as above said, not unnatural, under the conditions of the case thirty years ago, that the hypothesis thus proposed and guaranteed should go far toward replacing an earlier hypothesis that had till then enjoyed universal acceptance; but unhappily there is one condition of the case that, as already indicated, weakens it most seriously. Both the advocate and the champion of this hypothesis had omitted from their discussion a certain essential factor of the problem, namely the pattern of the central-island shoreline within barrier reefs; worse yet, they had, as above noted, completely overlooked a clear and conclusive statement regarding the pattern of the central islands of barrier reefs that had been published some thirty years before in easily accessible works by an earlier and highly regarded investigator of the coral-reef problem, who surely must have been known by name to both the advocate and the champion of the new hypothesis. Hence, natural as it was that the apparently complete statement of the still-stand hypothesis should have found wide acceptance, it must be given up when the previously omitted elements of the problem are found to speak unpromisingly against it.

*Veneering Reef on Wave-cut Platforms.*—Let us now turn to another hypothesis: one which, without the intervention of a fringing reef, explains a barrier reef by supposing that it is a relatively thin veneer of coral limestone built on the outer edge of a platform that has been cut by sea waves around a still-standing volcanic island; and which explains atolls without the intervention of barrier reefs by supposing them to be veneers on completely truncated, still-standing volcanic islands. This hypothesis, like the one already considered, postulates still-standing volcanic islands; in view of the small thickness of its reefs it may be called the veneering hypothesis. Here the associated problem that we must consider is somewhat more complicated than before, because it includes the attack of the sea around the undefended island margin as well as that of subaerial erosion over its surface. A special sequence of forms must be produced as an island is worn away by the double attack, and the chief members of the sequence must be deduced, in order that they may be confronted with the facts. It is curious to note that here, as in the case of the previous theory, this duty has been altogether neglected. Under the double attack, a volcanic island, originally conical and undefended by any reef, will soon be cut away by the waves around its shore, like Nightingale island in the South Atlantic, well figured in the narrative volume of the *Challenger* Report, while rain and streams are furrowing its slopes: the wave-cut platform will be backed by a steep cliff, notched at the top by hanging valleys, as in sectors *H* or *J*, Fig. 7. If a veneering reef is now established on the platform edge, as at *H'* or *J'*, the retreat of the cliff,

as a cliff, will soon cease, and the hanging valleys will be cut down to sea-level; deltas will grow in front of the valleys, and a talus will gather in the quiet water at the cliff base, which was clean swept by breaking waves before. If the veneering reef is not so soon established, the platform will be cut back to a greater width and the cliff to a greater height; this stage is verified by Tristan d'Acunha, another solitary volcanic island in the South Atlantic, also figured in the *Challenger* narrative; on such becliffed islands, cascades from hanging valleys have been described, which give warrant for the hanging valley as a deduced feature of sector *J*, Fig. 9. An undefended island may be almost consumed, as in sector *K*, when only small stacks will remain; or it may be com-

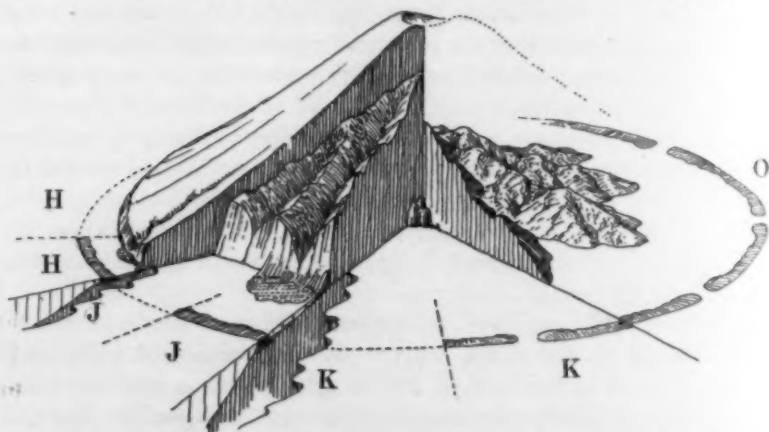


FIG. 7. DIAGRAM OF SUCCESSIVE STAGES OF REEF FORMATION, as deduced from the theory of veneering reefs on wave-cut platforms: sector *O*, type of actual barrier reef and its embayed central island.

pletely truncated before a reef is established, and then the reef will form an atoll.

*Unsuccessful Consequences of the Veneering Theory.*—Are the consequences of this theory, here graphically presented, confirmed when they are confronted with the facts of actual coral reefs and their associated islands? No, decidedly not. As before, the central islands of barrier reefs are again the most important independent witnesses put forth by the facts. Such islands are not cliffed around a non-embayed shoreline; they are, with hardly an exception, embayed between non-cliffed spurs, as in sector *O*, Fig. 7, or in Fig. 3. Furthermore, as there are many atolls in the ocean there should be also, if the veneering hypothesis were true, many almost finished atoll platforms; that is, many wave-swept platforms not yet enclosed by veneering reefs, with a becliffed island remnant rising from the center; but no such becliffed island remnants in the center of a wave-swept rock platform are known except on the borders or outside of the coral-reef zone. Again, there are no known examples of elevated reefs possessing the structure here demanded; elevated reefs are often hundreds of feet in thickness, and

in no case are they reported to lie on broad wave-cut platforms. Finally, this hypothesis is defective in that it furnishes no reason for the postponement of reef establishment while the platform is suffering preliminary abrasion, or for the early establishment of a veneering reef on a narrow wave-cut platform, or for the long delay before the establishment of a reef on a broad one. As a matter of observation, fringing reefs are occasionally found on young volcanic islands around which no cliff-bordered platform has been abraded, and after such reefs are formed, the waves can no longer attack the island back of the reef and cut platforms on it.

Is the hypothesis of veneering reefs perhaps recommended by any special expertness of its advocates? No. The first observers to advocate it were two missionaries, about eighty years ago. Did they deduce the essential consequences of the hypothesis, somewhat as above, and confront them impartially with the facts? No: they left that for Darwin to do a few years later; and when he showed that the central islands of barrier reefs have no such cliffs as the hypothesis demands, it was properly enough set aside in favor of his hypothesis of intermittent subsidence. But it was revived about fifty years later, this time by a surgeon of the British navy who had spent some years on certain islands of the coral zone but who was unfortunately untrained in physical geology; and again by a hydrographer, expert in marine surveying but apparently not practised in making critical choice among competing hypotheses; and by a zoologist and oceanographer of great experience, but in his case also without careful deduction of the becliffed consequences, and without any mention of the good and sufficient reasons that led Darwin to reject the hypothesis sixty years earlier. Did these later advocates of the veneering hypothesis give reasons for rejecting other hypotheses and preferring their own? It must be supposed that they thought they did, but their reasons are not convincing.

*Insufficient Consideration of Possible Alternatives.*—For example, one of them said: "I will pass over the theory of subsidence, supported though it was by Dana, Couthouy and Beete Jukes, because the recent facts concerning the ocean depths and the regions of living and up-raised reefs compel us to regard it as no longer necessary"; that is, of two alternatives, he rejected one because its postulated subsidence was made no longer "necessary" by the possible correctness of the other; but he did not apply any impartial and crucial test as a means of making a logical choice between the two. Again the same investigator said:

The more gradual the land-slope, the broader will be the submarine ledge [platform] cut out in the course of ages by the action of the sea, and the more distant will be the barrier-reef, that has grown up along its margin [as in Fig. 8]. This I believe to be the true explanation of the position of barrier reefs.

Yet is it not immediately manifest that the same relation will obtain

in upgrowing reefs during subsidence, as Fig. 9 shows; and is it not further manifest that if this relation is produced by subsidence, it must be associated with an embayed central island, like the unsymmetrical

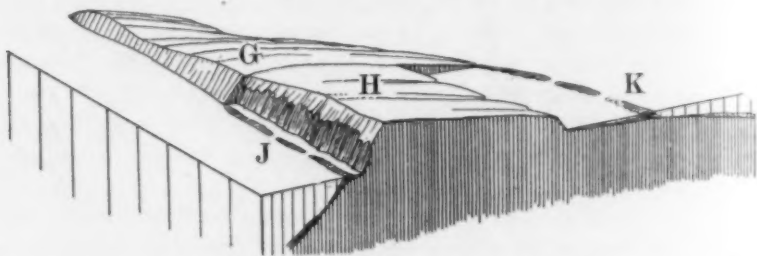


FIG. 8. DIAGRAM OF AN UNSYMMETRICAL ISLAND, *G*, on both sides of which, *H*, shallow platforms are cut by waves, and reefs, *J*, *K*, are formed.

fault-block island of Wakaya in central Fiji, as in the foreground of Fig. 10; while if it is produced by wave-cutting it must be associated with a cliff-rimmed, but not embayed central island, Fig 8, the like of which does not exist in the coral seas! Furthermore, there are well-known examples of central islands that have symmetrical slopes, but that stand to one side—sometimes to windward—of the lagoon center; witness, as in the background of Fig. 10, the island of Makongai, not far from Wakaya, both enclosed in a figure-8 barrier reef; or the

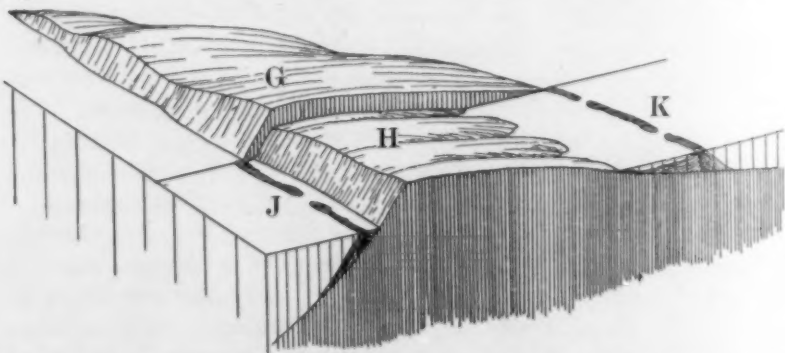


FIG. 9. DIAGRAM OF AN UNSYMMETRICAL ISLAND, *G*, which subsides, *H*, as reefs, *J*, *K*, grow upward alongside of it.

island of Mbengha, farther southwest in the Fiji group; these eccentrically placed residual islands are the natural result of the submergence of an unsymmetrical initial island, such as might have been composed of several unequal volcanoes welded into a single mass; and as they both have embayed but not becliffed shore lines, they must have been diminished by submergence, not by abrasion.

In view of such examples as these, all of which have long been charted, why should the author above quoted reject the possibility of submergence and accept the possibility of abrasion as a matter of

opinion or preference, instead of submitting both possibilities to some impartial and adequate tests, such as the presence of cliffs or of embayments so readily provides? The only answer is that he saw no necessity of looking for an impartial test; in other words, that his method

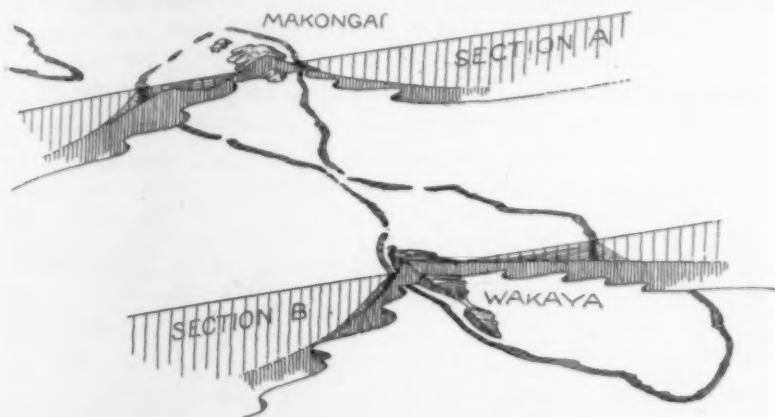


FIG. 10. BLOCK DIAGRAM OF WAKAYA, a tilted and slightly dissected fault block, and MAKONGAI, a maturely dissected volcanic mass, in the Fiji group; the two islands are enclosed in a double-looped barrier reef. Vertical sections, A and B, are drawn through the islands to show the inferred submarine relations of island to reef.

of scientific investigation was not the same as the one here adopted. He seems to have been satisfied because his theory explained the things that it was invented to explain; he asked nothing more of it! Not only so, some of his readers also were satisfied, and spoke of his essay with high praise: hence we must suppose that they too were ready to accept a theory that merely explained the things that it was invented to explain, instead of suspending their judgment until the theory should be shown competent to explain also certain other things that it had not been invented to explain. It is cases of this kind, which give warrant to the statement made on an earlier page, that in many pub-

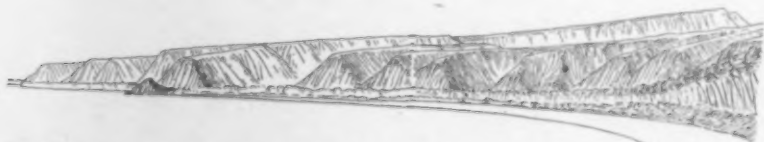


FIG. 11. SKETCH OF CLIFFED SPUR ENDS, northeast coast of the submerely dissected volcanic cone of Tahiti, Society Islands.

lished studies of the coral-reef problem, "the methods employed have been incomplete, illogical and untrustworthy, and the results reached are therefore unconvincing."

*Exceptional Examples.*—But has the veneering hypothesis really no independent support? Yes, in two exceptional examples the central islands of barrier reefs are cliffed around part of their margin: one is

Tahiti, Fig. 11, but there, as above intimated, it may be shown that the spur-end cliffs as well as the inter-spur valleys were cut when the island stood higher than now, and that since then the island has been submerged, for its valleys between the truncated spur ends are occupied either by arms of the sea or, more generally, by the heads of delta plains, as in Fig. 12. The other example is New Caledonia, which is strongly cliffed at its southeastern end and along part of the northeastern side; but as at Tahiti, these cliffs, as well as the numerous valleys of this long island, were cut when the island stood higher, and the



FIG. 12. BIRD'S-EYE DIAGRAM OF NORTHERN COAST, TAHITI, showing cliffed spur ends, separated by delta-filled embayments and prograded by a half-mile alluvial plain. The plain is for the most part covered with palm trees. Papeete, the capitol, lies on the plain to the left of the diagram.

same submergence that has embayed the valleys has half-drowned the cliffs. Hence, the two best examples of becliffed islands, though peculiar in possessing cliffs, are not peculiar also in having stood still, for both have suffered submergence. These islands are truly of great interest and merit special study; but they are as truly exceptions in the long list of reef-encircled islands, in which the spurs that separate the embayments, as a rule taper down gradually, and dip below the sea with nothing more than little nips or low bluffs cut by the lagoon waves close to present sea-level. The great majority of volcanic islands are not cliffed at all in the way the hypothesis of veneering barrier reefs and atolls demands, and for them the hypothesis must be rejected completely. Yet this hypothesis was presented with so convinced an emphasis by its above-quoted advocate, that an eminent geologist thereupon wrote:

I have read Dr. \_\_\_\_\_'s paper with great interest, and am of opinion that he has made out a very strong case indeed against the theory of

coral island formation advanced by Mr. Darwin. . . . The famous Darwinian theory of coral reefs can no longer be said to hold the field.

Another critic said that, if the facts and arguments here adduced had been known to Darwin,

the great naturalist would have accepted the explanation of the phenomena now formulated, and would have given up his ingenious theory of gradual elevations and subsidences of the sea bottom.

A third critic wrote, in view of the still-stand and the veneering theories:

It is somewhat surprising that, in the discussion which has lately [1883-1888] been carried on in the English reviews . . . regarding the new theory of coral reefs, no one should have dwelt upon the fact, that, with the exception of Dana, Jukes, and others who published their results on coral reefs soon after Darwin's theory took the scientific world by storm, not a single recent investigator of coral reefs has been able to accept this explanation as applicable to the special district which he has examined.

A fourth said:

A singular feature of these papers [at the British Association meeting, 1888] is the almost complete unanimity with which those authors, who have themselves practical experience of coral reefs, reject the subsidence theory as inadequate, or unnecessary.

Thus it would appear that Darwin's theory was well nigh abandoned. But none of these critics asked: Are the central islands of barrier reefs cliffed or delta-fronted, as they should be according to other hypotheses? All of which goes to show that the method of scientific investigation applicable to coral reefs is far from having been standardized; for as soon as the consequences of the hypothesis of veneering reefs are explicitly deduced and frankly confronted with the appropriate facts, the hypothesis must necessarily be given up by any independent investigator who demands that such confrontation shall be successful before he gives faith to the hypothesis that brings it forth. Yet this theory was set forth for the Great Barrier reef of Australia with such vigor by a zoological expert that another zoological expert declared the theory of subsidence to be "absolutely excluded" as an explanation for that greatest of all reefs; although the not cliffed but deeply embayed coast of Queensland presents abundant and convincing evidence that strong subsidence has taken place, as was pointed out by Penck in 1896, as has later been shown by Andrews and other Australian observers in 1902, and following years, and as I had occasion of seeing for myself along a stretch of several hundred miles in 1914.

*(To be continued)*

## THE EXUDATION OF ICE FROM STEMS OF PLANTS

BY DR. W. W. COBLENTZ

U. S. BUREAU OF STANDARDS

## I. INTRODUCTION

NOCTURNAL radiation is generally a passing of radiant energy from terrestrial substances into space. On a clear night the rate at which radiation passes outward from a lamp-black surface is very great, amounting to about one tenth of the solar constant. Of course, not all substances lose heat at this rate. This loss of heat by radiation produces peculiar formations of ice, some of which will now be mentioned.

*Ground Ice or Columnar Ice.*—The most familiar freak of ice formation occurs on bare, clayey soils which contain a certain minimum amount of moisture. If the moisture content of the soil falls below the minimum value (which no doubt varies for different soils) then evaporation occurs as rapidly as the moisture is brought to the surface (by capillary action) and no ice is formed. According to the writer's observations the ice is formed in contact with a nucleus which may be a grain of sand, a small pebble, etc. The earthy material has a higher emissivity than the water, it cools the more rapidly, and the water is frozen to the under side of the nucleus. As heat is lost, more ice is formed and, as it accumulates, rises in columns, as it is to be observed everywhere on cold mornings. The water is supplied by capillary movement in the soil, from the surface of which the ground ice may be readily lifted, since in freezing weather the ice is not frozen into the soil.<sup>1</sup> The general experience is to find the ground ice supporting a nucleus (say a grain of sand, or even large stones,  $3 \times 1\frac{1}{2} \times 1$  inches in size). The nuclei may be thinly distributed. The writer has observed several large areas,  $3 \times 1\frac{1}{2}$  feet which did not contain nuclei, from which it appears that this type of ice formation can occur without having a nucleus (gravel, etc.) to start the refrigeration.

*Anchor Ice.*—Barnes<sup>2</sup> has made a prolonged study of the formation of anchor ice at the bottom of the St. Lawrence river. This kind of ice consists of fine spicules which adhere to the bottom of the river. It is a friable mass which may vary from six to eight feet in thickness. According to Barnes this ice is formed as a result of the greater emis-

<sup>1</sup> Abbe, *Amer. Meteorological Jour.*, 9, p. 523, 1893.

<sup>2</sup> "Ice Formation with Special Reference to Anchor Ice and Frazil," H. T. Barnes, *Monthly Weather Review*, May, 1907, p. 225.

sivity, and hence the greater cooling of the material composing the river bottom.

*Hoar Frost.*—This is another example of ice formation as the result of cooling by radiation. Here, however, the accepted explanation is that the ice spicules are formed by accretion, as the result of the deposition of moisture from the surrounding air.

The foregoing are familiar and interesting illustrations of ice formations on substances as the result primarily of the loss of heat by radiation. We have now to consider a rarer phenomenon, which is the subject of the present paper.

*Ice Formations on Plants.*—According to the writer's observations the amount of ice formed upon a plant stem is a function of (1) the rate at which water can rise by capillary action in the sap tubes within the stem, (2) the ease with which the moisture can pass out to the surface, (3) the rate of evaporation from the surface (convection, wind-velocity) and (4) the emissivity of the surface of the stem. Instead of the title "Exudation of Ice," a more pretentious title would have been "*The Capillary Movement of Water—An Experimental Demonstration by Means of the Formation of Ice Fringes on Plants.*" This might appear more scientific and one could discuss the capillary movement of water as a function of the temperature of the stem; the size of bore and number of (sap) tubes; the thickness and permeability of the walls of these tubes, etc. However, the present communication makes no pretense at such completeness of the investigation. In fact, the subject of ice formation forced itself upon the writer at a time when other duties were pressing, and hence it could not be given the attention it deserved. As a result, the experimental tests were usually carried out only to the extent of refuting the various notions held by various persons as to the cause of this ice formation. It was shown that the formation of fringes of ice on plant stems is not the result of accretion, hydrostatic pressure, rifts in the stem, moisture in the bark, the presence of sap, etc., but that it is the result primarily of the capillary movement of water in the numerous sap tubes which are to be found in those plant stems, upon which the ice formations are the most conspicuous.

## II. HISTORICAL DATA

One of the earliest descriptions of the exudation of ice fringes from plants was published by Herschel,<sup>3</sup> about eighty years ago. His observations relate to the icy fringes which were formed around thistle stalks, and stumps of heliotropes many specimens of which were still green. Stephen Elliot<sup>4</sup> had previously described a remarkable protrusion of fibers of ice from the stems of flea bane (*Conyza bifrons*).

<sup>3</sup>Sir John Herschel, *Phil. Mag.* (3), 2, p. 110, 1833.

<sup>4</sup>Stephen Elliot, "Sketch of the Botany of South Carolina and Georgia," published in 1824; Vol. 2, p. 322. Quoted by Le Conte.

The fullest account, with an attempted explanation of this phenomenon, was given by John Le Conte<sup>5</sup> about sixty-three years ago. His observations are on two species of flea bane, *Pluchea bifrons*, and *Pluchea camphorata*, which he found growing in wet soils, around ponds and along roadside ditches in the lowlands of South Carolina and Georgia. In these plants the root is perennial, but the stem is annual and herbaceous.

Le Conte's descriptions differ materially from my own. His observations appeared to establish the following facts in relation to the phenomenon.

1. The depositions of ice are entirely confined to the immediate neighborhood of the roots of the plants, the upper parts of the tall unbroken stalks being quite free from them. They frequently commence two or three inches from the ground, and extend from three to four inches along the axis of the stem. The stalks are dead, and quite dry to within about six inches of the earth, below which they are generally green and succulent. The plant has a large and porous pith, which is always saturated with moisture, as high as six or seven inches from the base of the stem. From this it would appear that the ice was formed on the green stems, as was true of many of the specimens of *heliotrope* described by Herschel.

2. The ice emanates in a kind of riband, or frill-shaped, wavy, friable, semipellucid excrescence,

the structure of which (quoting Herschel) "is fibrous like that of the fibrous variety of gypsum, presenting a glassy silky wavy surface; the direction of the fibers being at right angles to the stem or horizontal." Le Conte found that the number of ribands varied from one to five, which issued from the stems in vertical or longitudinal lines, often unsymmetrically displaced around the axis. He frequently observed the icy excrescences to exceed five inches in length; often curled back so that the remote extremity of the frill came close to the line of attachment to the stalk.

From this it may be noticed that the amount of ice formed is very considerable. Evidently the moisture must come from within the plant. The amount of water congealed during a single night is vastly too great to come from the aqueous vapor in the atmosphere, hence the phenomenon can not be a modification of hoar-frost. In fact, in the illustrations to be cited presently, which were observed by the writer, the excrescences of ice on one particular species of plant were formed every night which was sufficiently cool for ice formation, although there was little or no formation of hoar frost anywhere in the vicinity.

3. Although the ice sheets appeared to protrude from the interior of the stem, both Herschel and Le Conte found that usually the stems were solid and that the ice terminated at the surface.

The point of attachment of the ice was always the wood, beneath the outer bark or epidermis, which the frozen sheets had in every instance stripped off, and forced out to a distance.

<sup>5</sup> John Le Conte, *Proc. Amer. Assoc. Adv. Sci.*, Vol. 3, p. 20, 1850.

When the frost was severe, Le Conte found that the ice ribband was continuous with the frozen pith, through a longitudinal rift in the woody stem.

4. Le Conte found that

the phenomenon took place in the same plant during several consecutive nights; and when the wood was not rifted, frequently from the same portion of the stalk. When the wood was split, however, the deposition of ice occurred lower down the stem, at a part which was unaffected by the frost of the previous night. The stalks thus became completely rifted by a succession of severe nights, from the height of six or seven inches down to the ground. This is unquestionably one of the reasons why these exudations of ice are seldom observed after the middle of the winter, for the stalks are usually destroyed before this period.

Ward<sup>6</sup> has given a rather popular description of the occurrence of ice fringes. He describes the fringes as projecting out horizontally, "not straight and stiff, but gently and gracefully curving or coiling into a beautiful conch-like roll at the distal end." His observations were probably of short duration, otherwise he would have found but few instances in which the "fringes are attached at regular intervals around the stem, like paddles of a turbine wheel." He found that the bark was split into strips at the zone occupied by the ice-sheets. He concluded that the ice had passed through these rifts in the bark. He thought that the water might have been pressed or drawn up through the cambium layer. He wisely dismisses the explanation because it "explained too much, since no reason can be assigned why the phenomenon should not be universal and not confined to one species."<sup>7</sup> In the present paper the micro-photographs of the cross-sections of various plants will assign this reason, viz., the difference in the porosity of the stems.

Le Conte considered the ice formation on plants to be a physical phenomenon, having no connection with the vitality of the stem. His explanation of the formation was that the moisture from the pith passes out along the wedge-shaped medullary rays, which are to be found in abundance in this plant, and is frozen on the outside of the stem. He considered that the wedge-shaped medullary rays exerted a "projectile force" which brings the moisture to the surface. The exudation of ice columns from the earth he referred to the same cause, viz., a rapid and forcible expansion along capillary tubes.

To the writer it does not appear necessary to postulate a complex "projectile force" to explain the ice fringes on plants. In fact, the plants upon which ice is formed in the great abundance have a preponderance of sap tubes, only an insignificant part of the stem being occupied by medullary rays.

<sup>6</sup> Ward, *Botanical Gazette*, 18, p. 183, 1893, "Frost Freaks of the Dittany."

<sup>7</sup> Ward quotes Gray's Manual, 1848, in which *Helianthemum canadense* is described as behaving in a similar way.

## III. RECENT DATA

The present observations are on *Cunila mariana*, or Dittany, the stem of which is a herbaceous annual with perennial roots. This plant seems to thrive on dry ground, even on bare hillsides exposed to the blazing sun, where there is nothing but gravel and a few "asters." Other samples were found under trees where either the shade or the gravelly character of the soil prevented a luxuriant growth of other plants. The finest samples were found on a hillside which contained plenty of moisture, which was free from trees, but contained shrubbery.

The first observations were made on a frosty morning in November, 1913. The first example, because of its white ribbony character, was passed by, thinking it was something thrown from a passing carriage. The conspicuous fibrous white loops and ribbons drew my attention, and it was at once observed that they occurred upon only one species of herbaceous plant.

Owing to the pressure of other problems requiring close attention, the tendency at the very first was to dismiss the subject by accepting Le Conte's explanation that the moisture comes from the pith. This explanation was at once disproved, however, by the observations on the splinters of the *Cunila* stem, which formed ice always on the outside of the stem, but never on the pith. This, of course, should be expected, for pith is composed of small hexahedral cells along which water can not pass by capillary attraction, and it would be very unlikely that it would be transferred by soaking through the cell walls.

It was concluded that the moisture for producing the ice fringe came from the sap tubes and experiments were devised to prove this assumption. Photographs were taken of thin sections across the stems of heliotrope, thistle and also of an aster which was found near a *Cunila* stalk. The object in giving these photo-micrographs (which were very kindly prepared by Mr. E. D. Tillyer) is to show typical examples which have but few sap tubes and which form but little or no ice; also typical examples of plants which have numerous sap tubes and which form an abundance of ice fringes.

The aster is typical of plants having but few sap tubes. As shown in Fig. 1, the woody structure is very compact, with but few sap tubes. All these photo-microsections are magnified fifty times, from which one can obtain some idea of the great difference in porosity of the different plants.

On only one occasion was ice observed upon the stem of the aster. The ice was a small "tooth" formed close to the ground. From the section shown in Fig. 1 it is evident that the structure of the wood fiber is so close that the moisture which is drawn up within the stem by capillary attraction can reach the surface of the stem at only a very slow rate. Hence the moisture disappears by evaporation as rapidly as it comes to the surface. The thistle (Fig. 2) and the heliotrope

(Fig. 3) stems have numerous large sap tubes. In the thistle stem there is a row of large tubes situated near the bark. The presence of

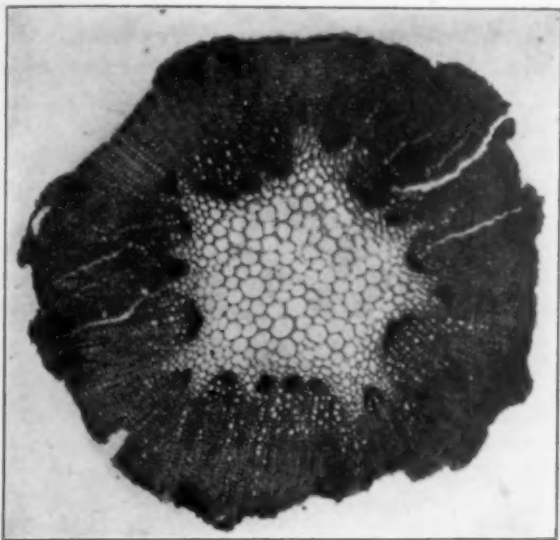


FIG. 1. PHOTOMICROGRAPH OF A CROSS SECTION OF THE STEM OF AN ASTER. It is typical of plants having but few sap tubes, and forming no ice fringes.

these large tubes filled with sap may explain the formation of ice fringes, as observed by Herschel.

A photo-micrograph of a thin section of *Cunila* is shown in Fig. 4. The numerous holes in the wood are the "sap tubes," which form an easy path for the moisture to rise within the stem, by capillary attrac-

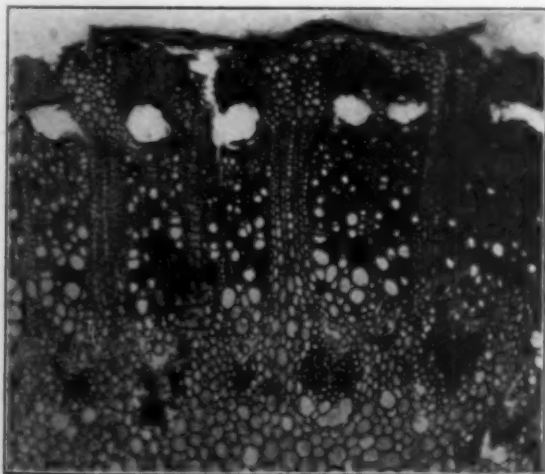


FIG. 2. PHOTOMICROGRAPH OF A SECTION OF THE STEM OF A THISTLE, showing numerous sap tubes.

tion. It would be interesting to determine to what extent this capillary movement of water is affected by the temperature of the surroundings.

The explanation of the formation of ice fringes, which are found to occur so abundantly upon the stems of the *Cunila*, and which are not found upon other plants, is based upon the presence of a great

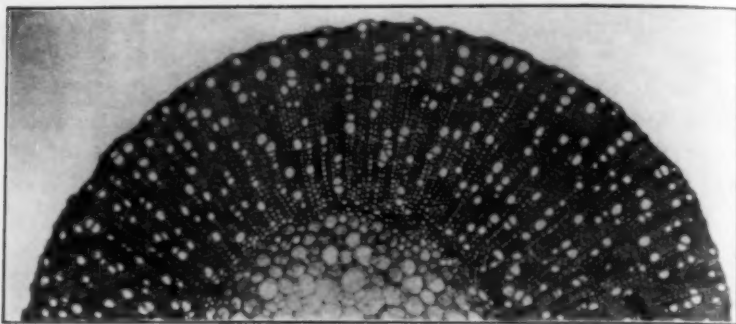


FIG. 3. PHOTOMICROGRAPH OF A CROSS SECTION OF THE STEM OF *HELIOTROPE*, showing numerous but widely separated sap tubes.

number of closely adjoining sap tubes within the stem of the *Cunila*. But even the very woody portion of the base of the *Cunila* stem was found to be inactive in the formation of ice fringes.

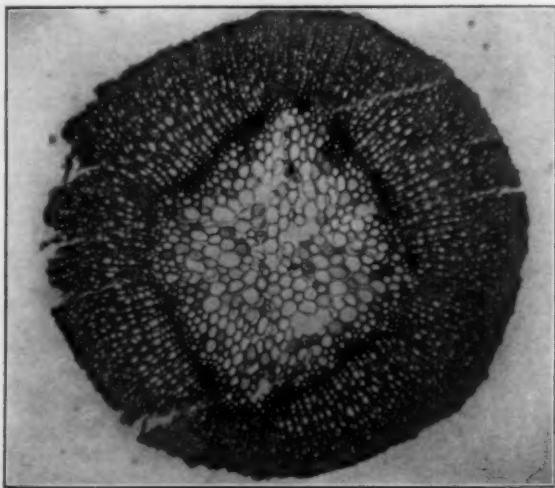


FIG. 4. PHOTOMICROGRAPH OF A CROSS SECTION OF THE STEM OF *Cunila mariana*. It is typical of plants having an abundance of sap tubes which transfer moisture to the surface by capillary attraction of the water in the soil.

It was found that the ice fringes rarely start from the side of the stem where the pith is closest to the bark. This eliminates to some extent the question whether the pith is instrumental in forming the ice

fringes. In the splinters (and in the rifted stems) of *Cunila* at no time was ice found to have formed along the line of separation of the stem. This seemed puzzling at first, for it appeared to contradict the idea that the moisture comes from the sap tubes within the stem; in which case one would expect to find the formation of ice fringes facilitated upon the surface laid bare by splitting. The microsections of the *Cunila* stems show in a very unexpected manner why no ice-fringes are formed upon the rifted surface of the stem. As already stated, the rift always occurs at the "corners" of the pith where the woody part of the stem is the thinnest. In Fig. 4 it may be noticed that at these four points, where the wood is the thinnest, there are but few, if any, sap tubes. Hence one need not expect, as a rule, to find ice formations upon the surfaces formed by splitting.

#### IV. OBSERVATIONS SHOWING HOW THE ICE FRINGE GROWS

One of the most interesting observations was on the formation of the ice fringe from its very beginning. This was witnessed by several of my colleagues who were called in to verify the observations. On a cold morning, February 16, 1913, several stems, placed in water, were exposed outside the laboratory window, and in about 20 minutes the ice fringe was observed to be forming. It consisted of a row of fine hairs extending up and down over a length of about 4 mm. of the stem, and projecting out horizontally 0.2 to 0.3 mm., as shown in Fig 5, a. These filaments were visible only when viewed against sky light, and they melted immediately on lifting the glass cover. The fringe did not appear to form at the line where the pith is closest to the surface of the stem. The experiment was repeated again during the evening. Within half an hour after placing the samples in the cold air one stem showed several fringes in the form of thin transparent "teeth," each one being about 12 mm. in length and about 1 mm. in height. Another stem showed a fine hairy fringe which was visible when viewed against a gaslight. Within half an hour this hairy fringe appeared to be solid with some of the fine hairs extending horizontally outward through the solid "tooth" of ice, as shown in Fig. 5, b. This, of course, is the general structure of the fringes. By the next morning numerous wide fringes had formed on these stems. In another sample, the tooth of ice pushed out a narrow strip of bark. In these tests the receptacle containing the water was small, and hence the whole cooled very rapidly and the water froze, which prevented the growth of the ice fringes. It is to be noticed that the ice fringe forms some distance up the stem at a point where it cools the quickest and where the moisture has risen to about its maximum height. The experiment was repeated ("Test C," which was started February 17, contained half a dozen samples of *Cunila* and a stem of an "aster") using a large test tube. The test tube was imbedded in wool to retard cooling and

freezing. Within 15 minutes after placing this test outside of the laboratory window two small fringes, 1.5 mm. long and about 0.3 mm. high, were noticed when viewed against sky light. This test was pro-

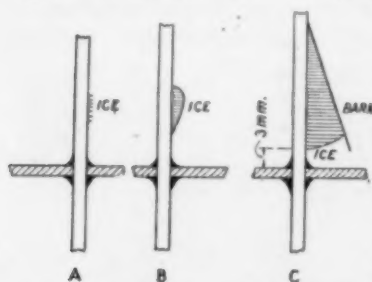


FIG. 5. ILLUSTRATING SUCCESSIVE STAGES IN THE GROWTH OF THE ICE FRINGE ON THE STEM OF *Cunila mariana* when placed in water and exposed to a freezing atmosphere.

aster stem, which is in agreement with the field observations.

As may be seen from Fig. 4, the *Cunila* stem on drying (shrinking) splits easily into four parts, owing to the small amount of wood fiber at the four "sides" of the stem. One of the samples used in "Test C" was a splinter, consisting of one quarter of the stem, about 6 cm. in length, with a line of pith adhering to the inner side. On the following morning, and on subsequent days, this splinter showed a fringe of ice on the woody surface, but at no time was there ice formed on the pith. An interesting feature (which to the writer became a common observation) was that the ice fringe did not always start at the "corner" of the stem where the wood is thinnest, but at a mid-point (see Fig. 4). From the photo-micrograph of a thin section of the stem (Fig. 4) it appears that the largest part of the ice fringe may form at the point where the sap tubes lie nearest the surface, hence where the moisture can be supplied the most easily.

longed for some days and nights and a photograph was taken (February 18, 1913) (Fig. 6) showing that the stems in water form ice just as they do when attached to the roots. In this photograph, which is magnified slightly (1.2) about one third of the upper part of the largest fringe is broken off. These fringes appear to be a little more transparent than those found in the field, owing to the fact that they had begun to melt while taking the photograph. No ice or moisture was formed upon the



FIG. 6. SHOWING ICE FRINGES FROZEN UPON STEMS OF *Cunila mariana* which were in a test tube containing water.

The ease with which these stems became saturated with water after having been drying for weeks is another item worth noticing. All the stems used in "Tests C and D" (Fig. 6 is Test C) had been in the laboratory for some time. Some of them had been gathered in November, 1913, and had been freed of bark by previous ice formations.

It is generally supposed that the ice is formed more easily in the fall (when the plants are fresh) than in the late winter. This seems to be true to some extent according to my field observations and to my laboratory tests. In the latter the ice did not seem to form so abundantly after the stems had soaked for some weeks. It seemed as though the sap tubes became clogged or the plant had begun to decay.

#### V. DESCRIPTION OF PHOTOGRAPHS OF ICE FRINGES

The attempts at photographing the ice fringes as they occurred in the woods were far from satisfactory. This was owing to the fact that at 8 A.M. the illumination was low. A wide stop was used in the camera and consequently the objects are in focus only in the center of the photograph. They serve the purpose, however, to illustrate their general appearance as found in the woods. The ice fringes are generally viewed at an angle at about  $45^{\circ}$  with the ground.

The photographs in Fig. 7 were obtained in January, 1915. They are typical of what one finds as regards size and general appearance of the ice fringes. The fringe in the lower right-hand corner is composed of three whorls. The open space in the fringe is shown by the round dark spot in the center. The photographs shown in Fig. 8 were obtained in the middle of January, 1915. The ice formation on the stalk in the lower left-hand corner of the photograph contains two beautifully folded fringes, the markings of which are unfortunately lost in the print.

The finest photographs were obtained by collecting a number of ice fringes one cold frosty morning (January 6, 1914) and having them photographed at the Bureau of Standards. Grateful acknowledgment is due Mr. E. D. Tillyer for his painstaking care in making these photographs, which no doubt are the finest records yet obtained of these beautiful ice formations.

In Fig. 9 the four most conspicuous ice fringes are lettered *a, b, c, d*, which makes identification easy in Figs. 10 and 11. In these illustrations the ice fringes were photographed from different sides. In Fig. 9, *a*, it may be noticed that the stem is free from bark. In Figs. 9 and 10 an extremely thin delicate fringe may be noticed protruding from what appears to be a rift in the stem, but what in reality is a piece of bark. It is an excellent illustration of the second stage in the formation of the ice fringe, as described on a preceding page and illustrated

in Fig. 5, 'b. In Fig. 10 the oft-mentioned, thin, wedge-shaped fringe (see Fig. 9) is shown to advantage, protruding (upwards in the photograph) from above the large fringes. The *Cunila* stalk (Figs. 10 and



FIG. 7. A COLLECTION OF 6 PHOTOGRAPHS SHOWING VARIOUS FORMATIONS OF ICE FRINGES ON *Cunila*.

11) shown in these plates is typical of what one finds after several ice formations, when the stem is well stripped of bark. The stem is 2.2 mm. in diameter and it is not rifted. As shown in Fig. 10, the "width" of the fringe adhering to the stem is 3 cm. It extends out horizontally 3 cm. from the stem. The distance from the stem to the extreme distal end of the loop is 4 cm. The weight of the ice formation is over 5 grams.

Fig. 9, 'b, consists of three splinters, united at the base of the stem. They are, of course, the remnants of the stalk which had long since disappeared. The dark line in the wood is the pith, which is shown to better advantage in Fig. 11. In

Figs. 9, 'd, and 11, 'b, the pith-side of the splinters is shown to advantage. We thus have a photographic record of the ice formation, not only upon the unrifted stalk, Fig. 9, 'a, but also of the formation on the rifted stalk, Fig. 9, 'c, and of the formation upon the bare splinters, Fig. 9, 'b and 'd. The fringe in Fig. 9, 'b, is an unusually interesting ice formation. The peculiar whorl in the center is the meeting point of two fringes (see Fig. 12) both of which began curving clockwise. The extreme thinness and the great transparency is to be noticed by the light and the dark streaks through the fringes in Fig. 9, 'd.

The small ice fringes on the stalk shown in Figs. 9, 'c, and 11, 'c, are of interest because they occur upon a thin stem which is split into two parts, the rift being easily distinguished in the photographs. In fact, most of the rift is above the ice fringes. This ice formation is also conspicuous in having pushed out some of the bark as illustrated in Fig. 5, 'c. This is an excel-



FIG. 8. SHOWING A COLLECTION OF FOUR PHOTOGRAPHS OF ICE FRINGES ON *Cunila*.

lent photographic record showing that the ice is not formed upon the pith (Fig. 9, *b*) or in the rift of the *Cunila* stem.

Figs. 9, *d* and 11, *d*, give a further illustration of the formation of ice fringes upon fragments of stems of the *Cunila*. The sample is a very small one. The stump of the stalk had to be cut out of the ground

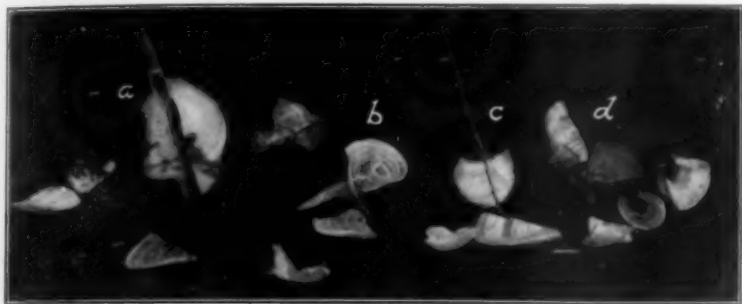


FIG. 9. PHOTOGRAPHS OF ICE FRINGES ON *Cunila maritima*.

in order to obtain the fringes. Some of the ground is still adhering to the stem. One of the fringes is broken off. The extremely thin translucent fringe (it appears to be dark, owing to the dark background) on the right-hand side of Fig. 9, *d*, is an excellent photographic record of the manner of growth of the ice fringe—as described on a previous

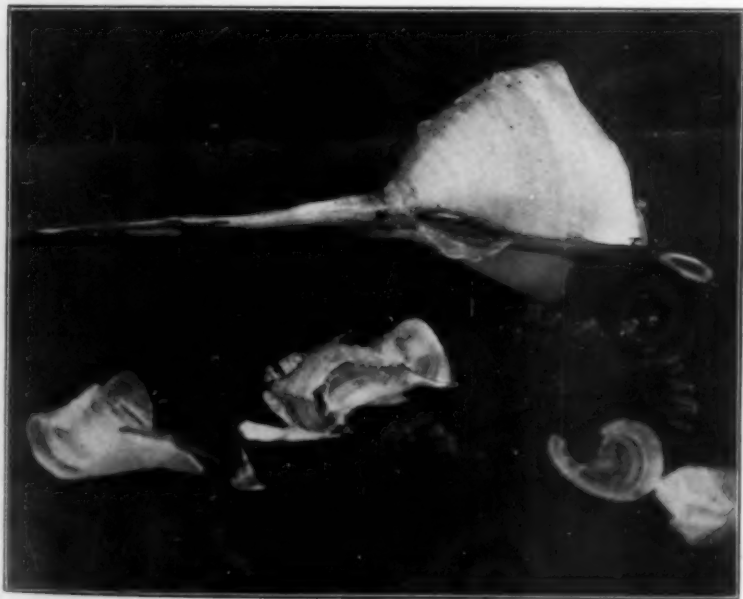


FIG. 10. ENLARGED VIEW OF ICE FRINGES ON *Cunila*.

page. The growth of the fringe is along a straight edge which appears almost horizontal in the photograph. This, however, is partly owing to the peculiar curvature of the fringe. The distal edge is straight and

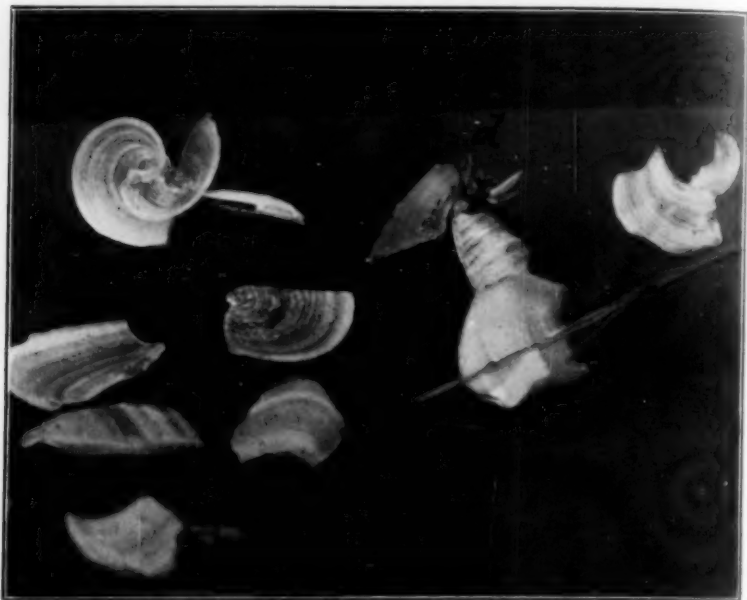


FIG. 11. ENLARGED VIEW OF ICE FRINGES ON *Cunila*.

smooth, just as it started when near the stem. The photographic record is therefore an excellent contradiction of the hoar-frost theory of accumulation in which the ice is formed in spicules. The dark streak

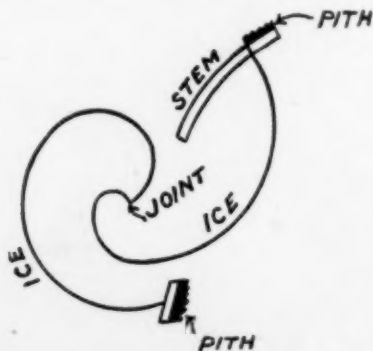


FIG. 12. ILLUSTRATING THE PECULIAR GROWTH OF THE ICE FRINGE SHOWN IN FIGS. 9 AND 11b.

along the fragment of stem is pith. The ice fringe is upon the woody side of the stem. In Fig. 12 is given a diagrammatic illustration of the whorled fringe shown in Figs. 9 and 11, b. All the plates show

fragments of ice fringes, the bright and dark streaks of which are owing to the difference in thickness and transparency of the ice. Fig. 6 mentioned elsewhere is a photographic record of the laboratory. It was

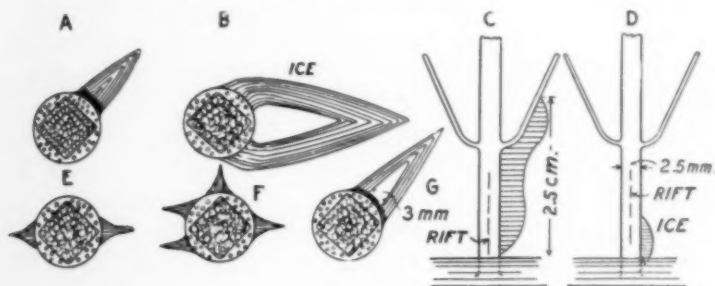


FIG. 13. ILLUSTRATING THE BEGINNING OF THE ICE-FORMATION AS OBSERVED IN THE FIELD AND IN THE LABORATORY.

taken by the writer Feb. 18, 1914. The test-tube was about 20 mm. in diameter, which gives one some idea of the dimensions. The test is described on a preceding page. This record is of interest mainly in showing that the *Cunila* stems after having been in the laboratory for some months form ice fringes just as they do when attached to the roots. In Figs. 13 and 14 are given illustrations of the growth of ice fringes

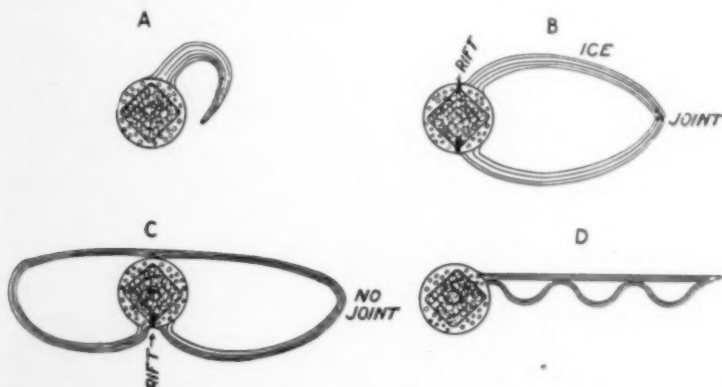


FIG. 14. ILLUSTRATING LATER STAGES IN THE FORMATION OF ICE FRINGES AS OBSERVED IN THE FIELD.

as observed in the field and in the laboratory. They are self-explanatory, and while it is true that they are diagrammatic, they nevertheless illustrate the complex and diversified manner in which the fringes occur. It seems needless to say that they are reproduced from sketches made at the time of observation.

## VI. SUMMARY.

This paper deals with the formation of ice fringes upon the Dittany, *Cunila mariana*. The data presented are based upon experiments and observations, in the field and in the laboratory.

It was observed that the ice fringes are formed when the temperature falls to freezing ( $0^{\circ}$  C.,  $32^{\circ}$  F.); but they are not a function of the hoar-frost which may be present upon the ground.

The ice fringes do not form upon the side of a splinter which contains the pith or upon the line of fracture, but upon the outer woody surface. The formation of the ice fringe, however, is not a function of the surface condition of the stem. The stem is frequently found to be cracked, but usually no ice protrudes from the rifts.

The growth of the ice fringe ceases when the ground is frozen to a depth of 2 to 3 cm., and when the moisture in the stem is frozen.

The size of the ice fringes and the height to which they extend above the ground depend upon the rate of evaporation from the stem, and upon the amount of moisture in the ground. Over 5 grams of ice may be formed upon a single plant during a single night.

Photographs are given of ice fringes formed upon stems which had been kept in the laboratory several months. They show that the ice may be formed upon stems without the roots. Hence the ice is not formed as a result of hydrostatic pressure exerted by the roots which are perennial.

All the observations are in agreement in showing that the moisture rises in the stem as the result of capillary attraction. The height (1 to 5 cm.) to which the moisture can rise within the stem is governed partly by the rate of evaporation from the surface. Photomicrographs of thin sections of plants are given, which show the structure of stems of plants which do not form ice fringes; also photomicrographs of sections of stems of plants which form ice fringes. It is shown that those plants which form ice fringes the most readily and in the greatest abundance have the most sap tubes.

The ice fringe is a composite of a number of very thin ribbons. In the laboratory the formation of the ice fringe was observed from its very beginning. The first stage in the production of the ice fringe consists of a single row of fine hair-like filaments of ice. This row of ice filaments lengthens up and down the stem. The filaments increase in number, thus forming a solid wedge-shaped tooth of ice, which constitutes the second stage of development. In the third stage of development the wedge-shaped tooth of ice widens and increases in length as the result of freezing of the water which continues to soak out of the stem. There appears to be no difference between the formation of

these ice fringes and the columnar ice formed on wet soils; other than that, in the latter, a particle of gravel usually forms the nucleus to start the congelation. In both cases the moisture is brought to the surface by capillary action. When the rate of supply to the surface is more rapid than the loss of evaporation, and the air is at a sufficiently low temperature, ice is formed.

## JAVA, THE EXPLOITED ISLAND

BY DR. ALFRED GOLDSBOROUGH MAYER

A SURVIVOR from an age of richer color than our own is the templed hill of Borobodoer in the middle of Java.

Here, more than a thousand years ago, the Hindu conquerors wrought honor to their "Mount of Buddha" by surrounding the dome-like reliquary at its summit with ten ornamented terraces of stone, encasing the sides of the hill in an ordered symmetry of angled walls, and portals, and of lattice-covered statues of the Buddha, all wonderful in the vast labor of the sculptured story of their creed.

Then, in after centuries, the sword and the Koran came from beyond the seas and the day of the Hindu passed, to be forgotten as only the East can forget a glory that has gone. Then it was that those who loved the old temple were forced to bury the doomed shrines beneath the kindly sod, and thus in oblivion they survived until the European came to cherish and restore.

Secluded in the deep country far from the haunts of trade, within but apart from the modern world, the temple lies as if dreaming in the spirit of its worshipper's Nirvana; peaceful in the sunset of its days, while green around it lies a valley rich in rice and palms, and, high above, one sees the smoking summits of volcanoes hushed in slumber.

The horde of Mahomet came and the Buddhist died in tragedy, yet after a thousand years the stones of Borobodoer remain as an Alhambra-like reminder of his culture and his pride; but Java with its thirty millions toils on unmoved by any inspiration from its past. Nourished in body, yet starved in spirit, it plods through its thousand rice fields within sight of the temple walls.

The garden *par excellence* of the tropic world is Java, yet intellectually it is but a cemetery of withered hopes and ambitions wrecked in mockery, for over all there broods the dull fatalism of despair—the "sufficient unto the day" of the conquered follower of Mahomet.

Ambition, if it exists in the Java of to-day, seems powerless to raise its people above the condition of the Asiatic peasant. There is no well-to-do class of native artisans, and one may travel throughout the land and find hardly a native shop upon whose wares the European may bestow a glance of admiration, save only for the vanishing art of batik cloth, and the still more moribund manufacture of the Krees.

Ant-like over the whole land, in every view, there swarms the dull-faced, docile coolie of the soil. Measured by standards of morality,

culture and ambition, the Javanese of to-day are negative. Their Mohammedanism is of an insipid type that tolerates the drinking of wine, permits women to go unveiled, is lax respecting the observance of prayer, and sanctions the representation of the human form in art provided the figures conform to the spider-like grotesqueness of the batik decorations. Even a pig fattens comfortably in the back yard, destined, however, to be sold to the "heathen" Chinese. A cloud of abnegation, the despair of a beaten race, broods over the whole land, and bright though the sun may be and green the fertile fields, the spirit of man is colorless and gray, and it is difficult to realize that these crouching, silent forms and averted faces, expressionless as drawn parchment, are those of the descendants of the warriors of Mataram.

How long will the inscrutable face of the East hold back the expression of its hate? One travels from one end of the land to the other and never a hearty laugh is heard, and the air seems heavy with bitter thoughts unuttered. There are latent things in Java more to be dreaded than the slopes of Krakatoa, where, under a fair covering of flowers, titanic fires lie hidden.

Granted that the only civilization is that which a race achieves for itself, never that which is thrust upon it, yet there is still something wrong here, for the present Javanese outlook upon life is narrower than it was in the past, and a primary cause of the continuance of the evil is not far to seek, for the Dutch, with all their admirable administration of affairs, have, as yet, done little or nothing for the general education of the masses of Java. In the villages, one commonly looks in vain for the temple of any creed, and the school-house, even when present, leaves much to be desired.

A few good schools for the sons of chiefs there are, and upon elementary native education the government spent in 1913 the paltry sum of \$1,321,000; and the much larger sum of \$3,000,000 upon the improvement and development of agriculture; an investment upon which Java returns a yearly interest, to mention only three commodities, of 3,100,000,000 pounds of sugar, 35,650,000 pounds of coffee, and 92,000,000 pounds of tobacco, the total of her exports amounting to fully \$75,000,000 per annum. There are 9,315,000 acres cultivated by the natives and the population of the island is 594 to the square mile; yet of its 30,000,000, the total native population of the five largest cities, Batavia, Samarang, Soerabaya, Djokjakarta, and Solo, is hardly more than 400,000. The vast mass of the people are agriculturalists living in thatched huts in myriads of little villages that cluster among the cocoanut groves of every valley in the land; and practically the only occupations open to natives of Java are those connected with the cultivation of the soil.

This narrowness of industrial outlook has, on several occasions, been

a source of commercial weakness, and Java has not always "paid," despite her conquerors' efforts to secure as much profit from her as their conscience and the public spirit of their times would permit.

The water supply of her countless mountain streams might turn the wheels of many a mill, but Java still sends her products abroad in the form of raw materials, and the cultivation of cotton is not even attempted.

It is a hopeful sign that the natives themselves are beginning to plead for education of a broader sort that will enable the more progressive and intelligent peasants to escape the fate of slaves of the soil, and it is probable that within a few years the Dutch government will respond and the prosperity and happiness of Java will be enhanced, for the Dutch have moved slowly, but surely, in the direction of altruism during their long occupation of the East Indies. They first appeared in 1595 under the lead of Cornelius Houtman who, after adventures and imprisonment, had ferreted out the secret of the route around the Cape of Good Hope to the Indies which the Portuguese had discovered under Vasco da Gama in 1497. Thus it was that the trade which had made the port of Lisbon the richest in Europe, now fell into the grasp of the Dutch East India Company, a corporation which became so powerful that it regarded itself as independent of even Holland's laws, and passed statutes adverse to the interests of its mother country, practically excluding Dutchmen not in the employ of the company from occupying land in the East Indies.

The methods employed in exploiting the natives, while more humane than those of the Portuguese, were still little above those of medieval Venice, and thus it was that, having thoroughly over-reached itself, the company failed in 1796 for \$50,000,000.

The natives, goaded to desperation by generations of injustice, broke out into insurrection, which Holland, having been overrun by the French, was powerless to quell.

Then came the picturesque Bonapartist, Marshall Herman Daendels, who governed the island from 1808 to 1811. By force of arms he reduced the power of the native chiefs to a shadow, the substance being maintained in European hands. The great road which he built throughout the entire length of Java from east to west, in the course of two years, is the result of his iron will, the head men of the villages being threatened with death unless they completed their task in time. Moreover, it was Daendels who caused old Batavia, "the white man's graveyard," to be practically abandoned as a residence by Europeans, and moved the capitol farther inland to a healthful site.

Daendels sought, also, to systematize the custom of "forced crops" which had been the rule of the old Dutch Company, at least in places and under various forms. About two fifths of the land suitable for

coffee was set apart and the natives were forced to farm it, the entire crop raised thereon going to the government. On the other three fifths of the coffee area the natives might raise their own crop, but they were forced to sell all to the government at a fixed price much below its actual value.

This autocratic career of Daendels was, however, cut short by the English conquest of Java, which resulted in the able administration of Sir Thomas Stamford Raffles between 1811 and 1815, wherein important and lasting reforms were instituted in the direction of "fair play" for the natives. Suffice it to say that with Raffles a spirit of effective altruism was manifested for the first time during European occupation of Java. In 1816, Java, together with many other East Indian islands she had lost, was returned to Holland; the Dutch profiting greatly by the results of the reforms brought about by the French and English.

Backslidings into old schemes of exploitation there have been, however, as when the government under Van den Bosch, which was in control from 1830 to 1839, took from each native a fifth part of his land upon which he was forced to raise for the government crops of coffee, indigo, sugar, pepper, tea or tobacco. In addition, the natives were forced to pay so heavy a land tax upon their remaining property that many of them defaulted and the government thus acquired the immense tracts which it still holds. In twelve years \$830,000,000 in taxes was wrung out of the down-trodden natives who, in order to escape starvation, were forced continually to clear and cultivate virgin soil; despite which the extortionate nature of Van den Bosch's plan was such that famine broke out in 1849 and nearly 500,000 victims perished.

The conscience of Holland was at last aroused, and the system of forced culture has been gradually abandoned, especially since 1870, so that to-day it is no longer a burden upon the natives in so far as their agricultural produce is concerned, although the system still dominates the conduct of the mining industry.

This system, cruelly unjust as it was, had certain good effects. It forced upon the natives habits of industry which they retain to-day, and also by greatly increasing the area of cultivated land it permitted an enormous population to be supported in health and comfort, if not in luxury. In 1816, there were only about 4,500,000 natives, while to-day there are nearly 30,000,000 in Java.

Steady progress in liberal reforms has been manifested by the Dutch since 1870. The island is governed through the direct agency of seventeen native regents who, however, are in each case subject to the "advice" of a Dutch Resident and owe their appointment to Holland. In most respects, however, the natives appear to be self-governing in so far as their immediate affairs are concerned and, indeed, the Regents are permitted considerable "play" if they conform to the spirit of civilization and to the customs of their race.

One thing the Dutch have done which we ourselves might well emulate in our government of the Philippines, and that has been the appointment of commissions composed of the best-trained scholars to study and report upon native languages, folk-lore, customs, arts, religion and history. Many authoritative volumes, unfortunately all in Dutch, have as a result been published upon these subjects and thus the officials sent out from Holland are already prepared to grasp the true inwardness of every native thought and act.

Intending officials in the civil service of the Dutch administration in the East Indies must pass an examination in many subjects relating to the East Indies, and must speak Malay, the official language, and one other native tongue before being permitted to qualify for any position of executive importance. The Dutch, in short, are trying to become the "big brothers" of the natives and a happier and more hopeful relationship is year by year developing in the East Indies between the white master and his brown ward.

This large-minded standpoint has been achieved slowly for, with many setbacks, it is the result of 300 years of association. Yet from this fact alone one may the more safely regard it as a final triumph of the right, and not as a mere transient, semi-sentimental, dip into altruism. It savors of fair play rather than of charity, and of mutual respect based not so much upon fear as upon understanding.

Narrowly self-centered, unaltruistic, and even predatory, the spirit of the Dutch government may have been in the past, but throughout it has been consistent in attempting to develop among the natives the habit of industry.

Under many a kindlier rule native races have lost ambition and have withered to extinction in the vile repose of apathy. Thus in all the world Java is the best example illustrating the fact that given habits of industry, a race can survive the ruin of its independence, its hope, and its pride, and multiply despite a conqueror's exploitation of its resources.

NATIONAL DEFENSE AND DEVELOPMENT<sup>1</sup>

## NATIONAL DEFENSE AND EFFICIENCY

BY S. STANWOOD MENKEN

NEW YORK CITY

THAT national defense considered merely in terms of men and machinery is directly affected by efficiency is too obvious to require any discussion. When, however, we consider defense of a country in the light of modern developments the extent of the influence of methods of efficiency is readily overlooked.

It is essential in treating the solution of the issue of a nation's defense that the nation should first determine its world position, its relation to other countries, and its attitude toward foreign ambitions; with this knowledge it can then measure its needs. Diplomacy is often referred to as the first line of defense. This is true, and it also must be understood that any defense not measured by the diplomat's recommendations is apt to be unfitted to national needs.

Once the need of national defense is determined, the country must look to the direct application of its assets for its protection; these assets constitute power which is derived from the human, physical and industrial resources of the state. The law of cause and effect determine the extent of the power and bear directly upon the state's influence.

In the past we have found happiness and growth with liberty in strict adherence to democratic principles. We have been greatly aided through our natural riches and the fact that conditions affecting our government were comparatively simple. To-day we have drawn to a large extent on the top soil of our natural resources. We have a more or less concentrated population of a hundred million of people of varied race origin, and find great difficulty in continuing a policy of freedom from entangling alliances. We have wedded ourselves to certain doctrines and thereby assumed certain national obligations without fully providing the means of enforcing them. The transition has decidedly complicated the position of our country and made the working out of its destiny a grave matter, requiring attention and prayerful thought of the best available minds.

When we stop and think of world conditions and measure the re-

<sup>1</sup> A series of papers presented before the Section for Social and Economic Science of the American Association for the Advancement of Science at the meeting in Columbus on December 30, 1915, arranged by the Secretary of the Section, Seymour C. Loomis.

morseless results of cause and effect in the light of knowledge of the economics and efficiency as practised abroad, as compared with our situation here, we can well doubt whether, unless a new spirit grips our land with grim determination, we shall enjoy a continuation of the blessings of the past. To America asleep, to an extent which makes it almost appear that the average man were blind and deaf to occurrences, the efficiency of the German army in the early days of the war was a startling apparition, and yet we know that it was merely one form of expression of the results of a system. The foreign governments that progress have mainly done so in a restricted area under great difficulties, to meet which they use the methods of the laboratory. They apply every human, physical and industrial element to the upbuilding of the state. They know that the success of their system is determined by the individual, personal unit. It is simple, if all cooperate with understanding and with a deep sense of personal obligation, and this sense is the base of natural power.

It is to the philosophy of Kant and the teachings of Fichte that the German spirit of duty to the state finds the impulse which has made German efficiency possible, whether it be evidenced in the army, industry, trade extension or town government. It would be well if America could understand the details of their progress in certain forms of science and of industry, or their success in treating municipal problems, an example of which latter proof of their skill we are able to note that in some cities there are not only no local taxes, but each freeman of certain cities receives a bonus, or dividend, through his citizenship. In one instance this is as much as \$100 per annum.

While I believe in individualism, and deny the necessity of the extreme control incident to state socialism, we must fully realize what other nations are doing, and gather what is good and useful in their methods, if we are to have the maximum national growth. If we would proceed with efficiency toward preparedness, we must have the benefit of all possible knowledge of what is being done abroad.

A new era has dawned upon the world. Internationalism, as a practical possibility, is dead for our generation, and our best service to mankind is to insure the maintenance of the growth of this republic. To do so means the preservation of liberty and all that prior generations of thinking Americans have advocated, either in times of war or of peace.

It is because I fear the aggressor, and am too conservative to gamble on the chance that we may not be victims as China and Belgium have been, that I urge with all my power that our country arm to the full extent essential for its defense against attack. America has a great destiny, not alone for service to its own people, but to all mankind, a trust not only for the present, but for future generations, and we can

not stand quiet and assume that chance or national aspirations for peace will furnish immunity; the risk is too grave. We are guarantors of world civilization, which may continue without us, but we must recognize the burden of the hour and meet it, arming and preparing on efficient basis to fulfill the greater purposes of world citizenship.

Preparedness means far more than mere ranks of men, stores of arms, forts and ships. It means the upbuilding of national character, the creation of a mental state of preparedness to do and work for the country on the part of the individual. It means industrial preparedness—it means all these things plus efficiency. In a word, we must, as men and women, give our best thought and apply our strength, character and industry to national upbuilding.

The basic element of any nationality is a people of like origin, speaking a common tongue, having a common understanding and ambitions. Our best defense is a united people. A country divided within itself must fall, and the first duty of our federal and state government is to take steps to unify our citizens of all origins. We must work first through the schools. Next, we should work through the centers of foreign populations. The melting pot has not done its work as yet, and it is possible to accomplish more if the fires of patriotism are heightened and the benefits of good government brought directly to the homes of all classes. This is a matter of serious moment, and it is here I should like to see methods of efficiency first applied.

Next, it is essential that we acquire a spirit of individual preparedness. Because we adhere to high ethical principles in our dealings with our fellow-men, we seem as a general rule to ignore civic duty. Each school should teach American history as it really is, telling the full history of congressional incompetence in regard to legislation, the failure to meet the abolition question for sixty years, the cost of this neglect in men and millions. They should also portray the moral effect of the toleration and continuance of slavery. The historian to serve us with truth should also review the handling of the tariff issue—sixteen bills in a century, with hundreds of disastrous amendments. Let them detail the incompetence of our treatment of trust and finance questions. Let them explain the several causes of the pork barrel legislation and the neglect of conservation of life and of natural resources, criminal beyond expression. I would have them also make clear the methods of the ring politician, the character of the parasites who allow him to be a possibility by lack of public morals and democracy; and, above all, I would like to see this—the history of unpreparedness and the penalty paid by this country in every war it has fought. I should like to see *this* taught with absolute candor, and so brought home to the average youth that he will fully understand the shortcomings of the past; recognize that Americans while personally fair are not super-

men, and feel that if he is to meet the full burdens of his citizenship in future, he has to do his part by personal service toward assuring good government, which will efficiently devote itself, through executive and legislative, to city, state and national affairs. In a word, we must have direct efficiency in government, we must eliminate fraud, penalize those who neglect to serve, and emphasize the fact that each and every citizen has to earn his right to life, liberty and happiness, and that every one is conscripted in that sense for public work.

If we can accomplish a reasonable degree of individual preparedness, all other matters will naturally follow. We shall then have industrial preparedness, which will be so arranged that in the event of our being attacked by any foreign power our manufactures and our commerce will coordinate to serve our army and navy.

To detail the mobilization of industry is not my problem. I wish merely to indicate the necessity therefor as a part of the preparedness which we have neglected. The application of like methods of efficiency to army and navy means the elimination of waste. Useless or improperly located barracks and navy yards are inconceivable in any scheme of national defense that is efficient. In view of our expenditures the conditions, disclosed by Congressman Gardner and accentuated by later developments, constitute a condition of evil for which each preceding national administration is responsible, each in turn. That Mr. Meyer for the navy, Mr. Stimson for the army, pleaded for freedom and funds to do better things does not excuse, but accentuates, the absolute need of new methods of efficiency in the service and strict accountability to the people.

We may advocate national defense and Congress may listen to our plea, but neither laws nor expenditure can give us real protection or preparedness unless we practise efficiency as individuals and as a nation.

### THE WISDOM AND ETHICS OF PREPAREDNESS

By HENRY A. WISE WOOD

NEW YORK CITY

AN examination of history, from the middle of the fifteenth century until the present time, discloses the fact that, if the principal European nations be lumped, 52 per cent. of their time has been spent at peace, and 48 per cent. in warfare. England, in 800 years, has spent 419 years at war, or over 52 per cent. of her time, while France, in the same period, has spent 373 years at war. In the twelfth century, England fought over 54 per cent. of her time, while in the nineteenth century she fought 53½ per cent. Not much of a reduction. France, in the twelfth century, fought 36½ per cent. of her time, and in the nine-

teenth century 35 per cent. These figures disprove the erroneous contention that warfare is decreasing.

If we turn to Prussia, the most efficiently warlike of all nations, we discover a very significant fact. Where, in the seventeenth century, Prussia fought 58½ per cent. of her time, by the nineteenth century—during the latter half of which she may be said to have made and absorbed the German Empire—she reduced her years at war to 13 per cent. By the development of military prowess and her thorough preparation she had learned to strike so swiftly and well that her wars were over almost before they were begun. If the war chart of Prussia be compared with those of other nations, all of whom were less well trained and prepared, it will be found that where Prussia quickly finished her fights and got back to work, the wars of the other nations were long drawn out, due as we know to the necessity of their learning and preparing to fight after their wars had begun.

From the foregoing it is clear that the world at large is now, as formerly, fighting about one half of its time, but that the nation which has made a scientific study of warfare, training and equipping its citizens thoroughly therefor, has succeeded during the last century in reducing its periods of warfare to little more than one eighth of its time. That military efficiency and readiness have a humanitarian as well as an industrial value none can longer doubt. That to be prepared to defend ourselves will be as necessary in the future as in the past, the scarcely diminished proportion of its time which the world uses in warfare indicates. But let us be able to defend ourselves so well that our reply to aggression shall be instant success in terminating hostilities.

At the close of the revolution our army was reduced to eighty men, to guard ammunition. By 1812 it had arisen to little more than 6,000, I believe, who were widely scattered along our frontiers. At the beginning of the war of 1812, there were less than 5,000 British troops in Canada, while we, having no army capable of dealing with these, were compelled to raise and train troops before beginning operations. If we could have sent a force of 10,000 regulars promptly into Canada, we should have brought the war of 1812 to an immediate and victorious conclusion, and have added Canada to our territory. Instead, we began to "prepare" after operations had begun, with the result that the war dragged on for two and a half years, during which we were compelled to raise 527,000 troops, and to lose our capital, which, following the Battle of Bladensburg, was taken and burned by the British. In this battle 5,400 American troops fled, with a loss of but 8 killed and 11 wounded, although they were attacked by less than 1,500 British regulars.

The war of 1812 cost, including pensions, \$243,000,000. At no time during the war had the British more than 16,500 troops in Amer-

ica during a single year. Had the United States, from the close of the revolution to the beginning of this war, taken the precaution to support say an army of 15,000 men, money would have been saved, there would have been little loss of life, no loss of industry, and Canada would now be part of our territory.

Upton, our great military historian, has shown us that at the beginning of the rebellion had the United States had a trained army of less than 30,000 men the rebellion could have been suppressed at the first Battle of Bull Run. If such a body of men, of even many times this number, had been maintained before the war of secession how little their cost would now seem when set against the five billions of dollars spent by the north and the south on the war, the four billions of dollars since paid out in pensions, the hundreds of thousands of lives lost, the ruin of the south, and the interruption of four years of social progress and constructive industry. In view of these facts can any one question the value of such insurance against war?

The general staff of our army has just shown us that the most warlike nation of Europe, in times of peace, can deliver upon our shores a trained force of 827,000 men in 46 days, and that the most warlike nation of Asia can deliver 238,000 men in 63 days. The general staff thereupon advises that in order to make us secure the regular army be increased at once roughly to 280,000 men, and thereafter be gradually added to until it has reached 500,000. And this, which the general staff considers a minimum, it says, must largely be supplemented by the militia as well as other civilian troops. During Roosevelt's administration we were the world's second naval power; now we are substantially its fourth, while Germany in sea strength is vastly our superior.

If the recommendations of the civilian secretary of war be compared with those of the general staff of the army it will be seen how miserably insufficient is the plan of the secretary to afford us security in the event of attempted invasion. And if the naval increase proposed by the civilian secretary of the navy be compared with the naval list of Germany, it will instantly appear that when the small and slow plan which has been prepared by Mr. Daniels is carried into effect, we shall still be vastly inferior to Germany.

Where the fundamental policies of two nations conflict there is bound to be friction, and where there is friction eventually there may be war. It is a fact that our Monroe doctrine, which has forbidden European nations to colonize in this hemisphere, is in conflict with the colonial policy of the German Empire, as may easily be verified by a perusal of the words of German economists. As neither nation probably will surrender its policy, we find here a point of contact at which danger may arise. Wisdom therefore dictates that, if we intend to enforce the Monroe doctrine, we provide ourselves with a navy sufficient for quick and effective use, if the doctrine be attacked.

Our Asiatic exclusion policy, as practised on the Pacific coast, conflicts with the national policy of Japan, which nation insists that its citizens everywhere shall be received upon a footing of equality with those of the other first powers. Thus, if we intend to maintain our exclusion policy, it will be necessary for us to have a navy sufficiently large to enforce it if challenged. If it so happen that the Monroe doctrine and our exclusion policy be challenged simultaneously by the nations affected, it will be necessary for us to have a navy large enough to defeat the world's second naval power in the Atlantic, and the world's fifth naval power in the Pacific. At the present moment we could defeat neither the two together, nor the first alone, having long since lost to Germany our position of superiority.

Were Germany, with her superior fleet, to make a feint towards South America, and thus draw our fleet in that direction, the remainder of her fleet could safely convoy to our shores the 827,000 troops which our general staff has stated can be landed here in 46 days, when we should suffer the outrage of invasion. If, on the other hand, our fleet were retained in northern waters to protect us, then Germany could easily establish herself in South or Central America, from which it would be next to impossible to drive her. This possibility illustrates the imperative need of our having at all times a fleet large enough to cover the Atlantic, and the Pacific as well, for, if Japan were to co-operate with Germany, we should there have to deal with the fleets of that nation, or suffer invasion of our western coast.

Were Germany to succeed in establishing itself in South or Central America, and there create a standing army and a military base, we should have the military dangers long threatening Europe reproduced within our own hemisphere, and they would soon require us to adopt compulsory military service and maintain an enormous standing army. If, on the other hand, we should shield South or Central America, and permit our own shores to lie open, then, as has been stated, we could easily be seriously hurt, for an army could be landed upon Long Island, sufficiently near to New York to reduce that city with the mortars which have been used with such effect in Belgium. With New York City and its surrounding territory in the hands of the enemy, an enormous indemnity could be levied, in which the whole country would have to participate, while humiliating terms of peace could easily be dictated.

In view of the foregoing, it is obvious that it is necessary for us to equip ourselves at the earliest moment with (a) a navy sufficiently strong to defend ourselves both in the Atlantic and the Pacific oceans, and (b) to establish upon both coasts a mobile army of sufficient dimensions to repel the expeditions of two nations if made simultaneously.

In view of the mistakes of the past and of the dangers which threaten us, it is plain that it would be arrant folly to refuse to carry out in full the suggestions of the general staff of the army, and the recommendations of the general board of the navy, of which Dewey is the head, which have just been made public. For, however much these will cost, that cost can be but as nothing to the huge price that we shall have to pay in life, devastation and money for our negligence, should our invasion occur.

That preparedness has its ethical side, John Fiske has shown. He has said that the closest approach to a condition of perpetual and universal peace that it is possible to attain among nations can be achieved only when the preponderance of military power has been gathered into the hands of the pacific peoples. It is obvious that our own form of civilization as well as the forms of civilization enjoyed by the other pacific nations are in jeopardy, so long as the machinery of compulsion remains wholly in the hands of those bent upon conquest. So it is apparent that humanity and the preservation of righteousness throughout the world, no less than our own security, require that we shall do our part to redress the balance of power which too long has been permitted to lie with the war-like nations.<sup>1</sup>

## THE LOGIC OF PHYSICAL AND MENTAL PREPAREDNESS

BY NEWELL B. WOODWORTH, A.M.

PRESIDENT-GENERAL, SONS OF THE AMERICAN REVOLUTION

THE first chapter of American democracy commenced with the Continental Congress and the shots of the "Minute Men" at Lexington and Concord, and ended at Yorktown. Now, after more than a century and a quarter has passed, the deeper meaning of October 19, 1781, can be seen more clearly. Then it was only the eager rejoicing over a great victory that had been achieved after many depressing months, during which the cause of liberty seemed destined to defeat. Now it is seen as a momentous event upon which was to be predicated the Treaty of Paris, which was to give the opportunity for the development of the greatest representative government the world has ever known—a government standing for the highest ideals of individual liberty and equality and of national and international rights of humanity. Thus, through the intervening years since Cornwallis capitulated, a greater responsibility has been developing, as the nation has

<sup>1</sup> Authorities consulted: *Researches of Woods and Baltzley*; Upton's "Military Policy of the United States"; The German economists, Schmoller, Hotzsch, Vintzer, Unold, etc.; Report, 1915, War College division, General Staff U. S. Army.

extended, upon those intrusted with the trusteeship duties of American citizenship; duties depending primarily upon the maintenance of the entity of this nation and of its principles. Upon this point of maintenance there is no difference of opinion, but as to the method there is a wide divergence. There are those who would have us continue in our present almost physical defenseless condition; there are those who believe in physical preparedness for national self-defense. Thus a present vital issue is clearly joined between these two methods, and the court of arbitrament is the public opinion of our citizenship.

Let us return to the days of Yorktown and ascertain what was believed by our forefathers. The revolution determined the American people could fight. The immediately succeeding years were to determine if what had been created could be maintained. It required six wretched years under the Confederation after Yorktown to bring them to the second crisis. In the adoption of the Constitution of 1789, the American people finally demonstrated their belief in the principles for which they had contested and accepted an instrument of power under which in succeeding years, nationality was to develop. In the preamble of this marvelous document of our forefathers, six reasons for their action are set forth, namely, union, justice, tranquillity, common defense, general welfare and liberty. While five of the six are dependent on force for effectiveness, let us briefly consider only the "common defense."

I believe it is both an opportune time and an advisable time for the subject to be considered in the forum of any assembled body of American citizens, for there are at the present time some sixty "peace-at-any-price," anti-armament and anti-enlistment societies arrayed in an active anti-preparedness campaign against this provision of physical "common defense." This is a subject of patriotism, not partisanship.

Our forefathers engaged in preparing the Constitution were very practical men, nearly all of them having been active participants in the revolution. Their leader was Washington, who, previously to his election as a delegate to the convention, and to his being elected its president, had given expression to a thought that can be considered as reflecting the sentiment of his associates on the subject:

It is a maxim founded on universal experience of mankind, that no nation is to be trusted further than it is bound by its interests, and no prudent statesman or politician will venture to depart from it.

Later, as president under the Constitution, he again expressed this same thought in the words:

There is a rank due to the United States among nations which will be withheld, if not hopelessly lost by the reputation of weakness. If we desire to avoid insult, we must be able to repel it. If we desire to secure peace, one of the most powerful instruments of our rising prosperity, it must be known that we are at all times ready for war.

In view of the expressions of so commanding a figure in contemporary thought and from one too who earnestly detested war, it is submitted as a reasonable inference that the makers of the Constitution realized their acts and with due deliberation referred, as one of the reasons for the adoption of the Constitution, to the necessity of a material self-defense for the nation. If this measure of "common defense" resting upon force was deemed necessary in the infancy of this then isolated republic, how much more so is it essential to-day, when modern inventions have eliminated time and distance; when we have as a nation, reached the position of a world power; when our possessions extend into both hemispheres, and when we have publicly announced certain international policies.

Against this assertion of unpreparedness, the radical pacifist, and I am referring alone to the "radical," as all thinking men are at heart pacifists as recognizing the horrors of war and deploring its existence—I repeat these radical pacifists vociferate that no nation is going to impair and disregard our national rights and honor, as this would be illogical; therefore no actual sufficient military or naval force is required for the protection of national entity or obligations, as reasoning is *per se* sufficient for self-defense.

Let us briefly analyze. The weakness of the argument is that the premises upon which it is based are conjectures. Who can assert with finality that no nation will attack us or seek to violate our national obligations? Has any radical pacifist the ability to absolutely ensure or guarantee the nation against such a result, as they venture to so positively assert is impossible? No, it is simply their personal opinion, to which they are entitled, even as those who deduct a different conclusion from events are entitled to their views.

Again, who is to determine whether war in the reasoning capacity of a nation appears as logical or illogical? These logicians of pacifism give us no practical guarantee that will comfortably ensure the acceptance of our reasoning as correct by other nations. Belgium invaded did not consider the action of Germany either reasonable or logical; but Germany did, and Belgium was devastated. Our logic has thus far failed to be unanimously accepted as correct by the warring factions in Mexico. While this theory is quite idealistic and desirable, both from a humanitarian and an economic standpoint, the vital question yet remains a simple one of reasoning, dependent on man as he is mentally and physically constituted in this twentieth century A.D., and not as he perhaps may become later through many centuries of evolution. I place emphasis upon man, as he is yet a creature influenced by self-interests and by human passions. It is man, who yet develops and guides the destinies and policies of nations; the personal equation still controls governments. Selfishness is yet a predominant human characteristic.

To return again to our ancestors, they thought they had reached after the close of the revolution, an idealistic state of man uncontrolled by enforceable law sustained by force, and it required the lawless and turbulent years between 1783 and 1789 to harshly demonstrate to the worthy descendants of Pilgrim, Puritan and Cavalier their error and release them from their thralldom of misery. As General Knox at this time wrote, "Men, actual men, possessing all the turbulent passions belonging to that animal, must have a government proper and adequate for him," and experience then was so fast demonstrating to our forefathers that an "adequate" government was one backed by physical power to enforce its mandates, that they adopted the Constitution of the United States as a "government of laws and not of men." What was then true as regards our domestic government remains true to-day as regards foreign relations, as we have yet no brotherhood of nations to correspond to our brotherhood of states controlled by a strong federal system resting upon a force sufficient to compel observance of its mandates. Our federation ends at our boundaries. Beyond lie different races with different interests and methods of thinking; different customs and forms of government. Each inspired and controlled by its interests, and by the passions of the men who are its active component parts. Who can prophetically foretell or foresee the latent motives that may at any time suddenly bring their principles impelled by so considered self-interests into direct conflict with those of this nation, with only war remaining as the court possessing jurisdiction over the issues raised. Treaties of arbitration are only enforceable like statute and constitutional laws when sustained by an enforcing power, otherwise they become "a scrap of paper."

I do not question the desirability of the pacifist plan; only its present availability. It will doubtlessly develop some time in later centuries. It has required over seven hundred years since Magna Charta for individual liberty and constitutional government in a few of the individual nations of the world to develop to its present imperfect state, for the system is still in a process of realization. Doubtlessly, when this form of government further spreads over the world, as it probably will, as democracy is elementally and historically progressive, the time will be approached when an international constitution of power may be evolved and a permanent union of nations under it rendered as possible and as practicable as is this Union of States under our Constitution. This is, though, of the far future, for despite the assertions of the rationalist philosophers of the pacifist school, men, apparently from recent events, are not yet governed much more by reason and logic and less by human passions than they were in past centuries. These philosophers, who so believe, I fear, are seated upon lofty heights and look over the heads of common human nature below.

We have founded here in this western world a republic, with its doors opened to all races and creeds, rich and poor, literate and illiterate, who have desired to seek personal liberty and opportunities beneath our flag. The duty of those of the present is to preserve these institutions of liberty and to transmit them to their successors in all purity. In so doing we will enlarge our influence in the world and hasten the advance of the ultimate establishment of a permanent international peace. God forbid that we Americans have reached that apathy of mind where it is folly to risk a hair for the mere idea of what some "fanatics" call one's country. Rather, let our youth continue to feel that an adequate defense is a noble duty. If not it is time to return to our Virgil,—"*Arma verumque cano*"—I sing of arms and the man. Rather this than "I didn't raise my boy to be a soldier." No, if war is always wicked and peace beautiful, we must inexorably place George Washington and Abraham Lincoln in a class of murderous leaders and not as the creator and savior of the Union. Is this startling? It should not be. According to the logic of radical pacifism, the men who died on the battlefields of the Revolution and of the Civil War, irrespective of North or South, were not patriots, but rather men who went forth with murderous intent and as the deluded victims of unscrupulous leaders. I, for one, am not ready to accept any premises that lead to such an unholy conclusion. I can not see any valid reasons against an adequate, material self-defensive force for this nation. I can see many forcible reasons drawn from history and life of the imperative need for the security provided by such a proper force. I believe the great majority of American citizens are in favor of "common defense" as inheritors of the principles of the founders of this republic. If they had been "peace-at-any-price" men, they would have, after King George denied their petitions for redress, continued to peacefully lick the British stamps for affixation to their documents. This action would have avoided the revolution of '76 and probably involved our pacifist of the present in the current war as a colonist of Great Britain.

From the record of past events and from the observation of the present character of man, I can only logically deduce from these premises the necessity of physical self-defense. The methods of this preparedness I do not even assume to suggest. This is a question that we should wisely leave with those possessing the highest technical knowledge that the study of a lifetime can alone provide. There is only one question to be deliberately determined, without thought of partnership, only as Americans, by the citizens of this country, and that is physical preparedness, or unpreparedness.

Quite as essential as physical preparedness is the mental preparedness of the nation. This question arises more prominently at the present time because of the heterogeneous mingling of many races in our nation

and of the resulting concentration in recent years in our populous cities of these aliens in racial communities. Hitherto, the great amalgam which has fused into our body politic the many nationalities that have come to share our birthright, has been our common language. In racial districts where the inhabitants are using their native tongue, this language amalgam can not operate, and the alien, continuing to think and speak in native ways, is unassimilated. Obviously, such conditions constitute a menace to that complete unity of our people upon which must ultimately depend a mental preparedness from which must of necessity develop any effective physical preparedness.

Citizenship, whether by oath or by birth, demands loyalty to country. What is required in all is that spirit of loyalty that led Paul of Tarsus to exclaim, as bound and sentenced for scourging and an object of contempt, he brought consternation to the scarlet-clad Roman centurions in his acclamation, *Civis Romanus sum*—I am a Roman citizen—or of Patrick Henry in the halls of the Continental Congress, "I am not a Virginian, but an American." It is a long step, through many centuries filled with the incessant struggles of mankind towards a higher degree of Christianity and civilization, from Paul in the *acra* to Patrick Henry in the Continental Congress, but the words of both, far beyond a mere oratorical expression, represent the very living spirit of political liberty that should thrill with vibrating impulses every citizen of this nation. This active consciousness of loyalty to principle, so essential to the homogeneity of any nation, can only be aroused by teaching our alien citizens through school, precept and example, our language, our methods of thinking and our standards of living; and to all, whether Americans by heritage or by oath, a reverence and love for our flag and a pulsating pride in the protection it affords and in the principles it symbolizes. In seeking this desired result, the thought must be kept distinctly in mind that the essence of a democracy is service to all the people within its precincts, and we must use our influence that such service will be rendered from which impulsively will spring loyalty to country. True patriotism is never an emotional sentiment produced by temporary exhortation; it is the result of a slow growth inspired by the thought that each possesses an interest in a government that serves and protects. It is this deep possessive feeling as to country that leads men to defend their heritage even at a sacrifice of life. It is the depth of this spirit that rallies a nation to unity of action in times of stress, sustained in the hours of adversity and leads it on to victory.

This subtle moral mobilization of the people is quite as essential to the security and permanency of a nation as is the outward physical preparedness of military training and supplies. It was this spirit of disciplined loyalty that gave Rome all its magnificent glory; gave its citizens their pride in the protection of their eagles; gave Paul the poor

tent-maker of Tarsus his exultation of spirit, and, when it failed, the Gothic hordes poured through the Salerian gate and Rome fell. It was this spirit that rallied the "Minute Men" at Lexington, Concord and Bunker Hill, and brought the yeomanry of the colonies forward in every crisis of the revolution. It is a spirit closely akin to the spiritual feeling that distinguishes us from animals. It is the spirit upon which rests all that is worth while in this world of which we are a part in service to our democracy as representing our fellow-men. It is this national spirit that we must teach by word and by example with quickened conscience of the responsibility resting upon us. It presents an opportunity, both collectively and individually, to render national service to our country that we may, through living our own lives, justify our pride in the acts of the founders of this republic, at a time when alone service secured success.

The question we must each ask ourselves is:—Are we giving to our country the actual service for its advancement that we are capable of giving? Citizenship is a trusteeship. The pacifists who proclaim they are quite willing to take a chance on any nation attacking us are placing the future of the republic upon the forbearance of others, not upon the power to assert such a perpetuity. A plan hardly in accord with American traditions or the obligated duties of trusteeship. Again, these chance-taking pacifists overlook the salient fact that they can not separate themselves as individuals from citizens. To them has come, whether by heritage or by oath is immaterial, a life interest only in our government which protects them by its laws and institutions; and, like any life tenant, they have no right to so use this temporary individual interest as to imperil the principal in trust being transmitted intact to their successors. The fallacy of the endeavor to separate individuals and citizen interests is obvious. Rather may we turn to the heroic adherence of the citizens of Belgium to their obligations, even at the cost of war and devastation, as an inspiring example to the people of the United States. Citizenship carries duties of to-day, duties for the to-morrow. God grant that we may realize our opportunities and avail ourselves of the opportunity of service, zealously defending and continuing this republic, not only as a radiant promise, but as a full realization to all races of the world of a government of unity "of the people, by the people and for the people" under the principles represented by our glorious Stars and Stripes. God grant that we may continue to be inspired by the example of our forefathers in placing principle before all things, that we may not be led astray from our present opportunity of practical service to our country. Give us this mental preparedness backed by a proper defensive physical preparedness and this republic, sustained by the integrity, intelligence and conscience of the American people, will lead the way among all nations of the world to an ultimate federation of nations that through

democracy and the wisdom of a Divine Providence, will yet be created to bless all nations with an everlasting peace.

When the war-drum throbs no longer, and the battle-flags are furl'd  
In the Parliament of man, the Federation of the world.

## NATIONAL DEFENSE AND EDUCATION

By HENRY H. WARD

VICE-PRESIDENT OF THE NAVY LEAGUE OF THE UNITED STATES

THE "educators" of our country seem to have been among the last of the more intelligent body of the public to awaken to the necessity—even to the barest idea of the meaning—of national defense. I say "among the last," for among the more intelligent they are far from being alone in their apparent obliviousness to this vital public question.

However, in this attitude, the educator does stand as a most striking figure, in view of the particular relation which he holds to the public, as one whose profession is to impart pure knowledge on whatever subject. Apparently he has been little, if any, better informed than the average intelligent man of other professions. In fact, outside of the naval and military professions themselves, including, of course, the National Guard and Naval Militia, and outside of one or two heretofore struggling patriotic organizations, there is practically no scientific or consistent interest shown in this subject. Even our best informed men in civilian life, unless they have been brought into actual contact with naval and military administration, fail to recognize that here are two actual professions. Many of us so often pass them by with the idea that the army begins and ends in the few thousand men wearing uniforms and trained to a certain disregard of life, be it their own or that of others; the navy we look upon as little different from the army, except as it may be thought to differ in the matter of romance, or in the supposedly free and easy life of the sea and careless travel.

Now that the educator, along with other intelligent men, is awaking to the meaning of national defense, and to our country's need for it, his interest is becoming vivid and his activity dynamic. He stands forth potential for great national service, but not without some possibility for harm. There is, then, the greater need that he intelligently direct his efforts. The proselyte to the cause, be he educator or whoever he may be, starts out relatively ignorant of a vast subject. He learns a little, fails to realize the nature or extent of the subject before him, and, enthusiastic for this or that method or measure, not infrequently gives his energies along some misdirected line, or fails to realize full value from the energy that he expends.

There seems, too, to be a certain confusion, or lack of understanding, as to the alignment of public opinion, intelligent or otherwise, on the

matter of national defense and preparedness. It is too often assumed that the work of the so-called defense societies, and of the peace organizations, are necessarily entirely antagonistic. That such is not the case, provided we exclude the possibly mythical "Peace at any price" section, a moment's reflection should convince you.

What, then, is the function of the educator in respect to these questions, and where lies the relation between education and national defense?

For years back, various organizations have been endeavoring to conduct a work of public education as to the proper means of national defense. Conspicuous among these bodies, and oldest of those now active before the public, is the Navy League of the United States, which, since its organization in 1903, has been single in its purpose to inform the people of the country as to the needs of the navy and the country's need for a navy. Officers and workers of the league know only too well the country's past apathy toward this subject. Where there is apathy there can be nothing but ignorance; and upon this subject the country has been and is to-day woefully ignorant. We have been awakened by the European war. It is true that our interest is aroused, we are more willing to believe what has been told to us, but, so far, it is largely a matter of faith, and if we are to give wisely of ourselves, we must be taught.

Two years ago there were few who would have known whether our battleships were faster than those of England, of Germany, and of Japan; and, except for the boyishness of the American heart, few perhaps would have cared. Our dailies, and our periodical press, gave us recurring accounts of the launching of this vessel or of that. And were we not always told that each was the best in the world? To-day we have a little education on the subject. We know that those same ships, powerful though they are in many respects, are relatively slow; and, the while we are ceasing to be boys, we are beginning to care a great deal. We are no longer satisfied with the easy and boastful assurance of a few months ago. We want to *know*. And we want to know that we *have* the best in the world, or, if we haven't, how we can get it. We want to know this, not only in regard to battleships and battle cruisers, scouts, destroyers, submarines, fuel ships, hospital ships, supply ships, repair ships, air craft, mines, mine layers, mine sweepers, guns and armor, torpedoes, dry docks, navy yards, and shops and shipbuilding slips, and in regard to naval organization and administration, but we want to know how we can get that best in whatever else is needed in that other great branch of our defensive service—the army. Shall we know if we listen to the ignorant? Have we learned enough to form any adequate conception of these two complex establishments that must be welded into a harmonious whole for national defense, each one presenting in its manifold ramifications two great sides—each based upon and guided by a profession rivaling in complexity, specialization, and variety any in the

world, and yet each in its physical embodiment challenging our great industrial establishments, and together destined, should the hour come, to mean for us life, and perhaps honor, for self and family, and for the nation? If we have learned so much, we shall not be satisfied to take our further lesson from any tyro. The "two-man submarine," that patent David, child of an ignorant brain, will fail to charm us. "What do the doctors of the profession say?" we shall ask. We shall require to have their answer given freely, and without tincture of politics or of politicians, and without thought of money cost. And when we have heard that answer, we shall say if we can pay the price. But, as responsible beings, we shall have informed ourselves of the dangers of unpreparedness and as to our ability to pay. With the catastrophes of Europe and of the Near East before us, with history with equal lessons of horror, and with its other lessons to guide us, can we doubt what our decision must be, even if the chance of attack be slight, and the cost of safety great?

Even to-day we are walking in the dark. We have been cheered by the announcement that the Secretary of the Navy has approved a five-hundred-million-dollar construction program. It is true that it is to extend over a period of five years, but that is the rate of one hundred million a year for new construction, and heretofore we have spent a bare one hundred and forty millions or so annually on the building and maintenance of the whole navy. We picture to ourselves this money already buying us the protection that we are beginning to think we need, but how few of us know, or have ever informed ourselves, of the laborious, halting course of routine appropriation and expenditure of government funds for construction. Five hundred millions of dollars—the words ring big. The truth of the matter is, as shown by the Secretary in his own report, that not over fifty-seven millions of this is required for work to be done before July 1, 1917—one year and a half from now. Added truths are that probably not one dollar of this whole sum will be spent on new construction for another nine months unless extraordinary measures are brought into Congress to accomplish it. For years past, it has been the rule that from eleven to twelve months have elapsed after the secretary's report has been issued before the first dollar actually goes into a battleship, and it is only when it gets into the battleship that the dollar does any good; or, I might better say, that it is even then two years to the time before a ship is finished, and the dollar will really pay us back in the shape of tangible protection.

The events of the past year show an even more discouraging state of affairs. It was considered, for reasons that can not fully appeal to the mind sincerely believing in the necessity for national defense, that we should not accept the bids of private shipbuilders for the construction of certain recently authorized battleships. Instead, their building has

been entrusted to navy yards, and pending the fitting out of the yard with the proper facilities, and the getting of the necessary appropriations from Congress for that purpose, nothing will be done, and ships authorized nearly a year ago will not be laid down for months yet. I do not intend to suggest that there is inherent objection to the building of ships in navy yards, but only that they should be built where they can be most quickly built. A similar mental attitude has resulted in a failure to recognize that the only dry dock that is worth anything for national defense is a dry dock built and completed, and not merely a dry dock authorized, or half erected. This attitude has delayed for one year authorization to resume work on the dock at that important naval outpost—Pearl Harbor—in the Hawaiian Islands. A state of mind, similar to the one just mentioned but similar in only one respect, that of its blindness to public interest, has left the naval station at Guantanamo uncompleted, because it was so much easier to get appropriations for Boston, or Charleston, or Portsmouth, New Hampshire, or New Orleans, or Brooklyn, or Pensacola, than for Guantanamo, where there is nothing else but the country's ends to be served. The fault does not lie with any one party, or with any one group. It lies with us who have failed to inform ourselves, and with those of us who, being informed, have not had the strength or public spirit to inform others.

Let us not be turned from the truth by the ignorant, the weak, or the insincere. Let us not believe when we are told that "Protection does not protect," or that we can not "afford" the cost, or, more specifically, that we have not the shops or building slips to build what the experts say we need. Protection has protected England for centuries, is protecting English homes and honor to-day, and, though at the further cost of tens of thousands of gallant lives, is giving new life to hundreds of thousands equally gallant, who have been willing to risk their all for honor and their country. The cost? A paltry billion or so spent as soon and as wisely as we can spend it, not spread out over years to come, spent while England and France and Germany are each spending their billion in every three months, will more than do it all. The shops and shipbuilding slips? The General Board of the Navy—our doctors—have said that we can have for the first year a program double that put forward by the secretary of the navy. And if our doctors are wrong, get from the broad profession of the navy better and more competent advisers for the future, and in the meantime, to correct our mistakes, put our hands in our pockets, spend the money, and build the slips and shops, and do it right away, not a year from now.

Now, the way to decision free from doubt, and the way to action in this matter, lies in knowledge and understanding, and, as always, the way to knowledge and understanding lies in study—in education. We must study; we must educate ourselves, and then take our part in edu-

cating others. When we have learned what our condition is, when we have learned, for instance, that the ocean is the surest, quickest, and safest highway for a foe, unless we can outmatch him upon that ocean, when we have learned the truth of our past military history, its failures and extravagance, we shall see clearly where lies our only hope for the future, and doubt will leave us. Here is legitimate work for the universities, the colleges, the schools, and the teachers and students of this country. It is not their part, commendable as is the spirit, to put forward schemes for military instruction and training within academic walls. If this be part of the military scheme recommended to them, let them take it up; but for their own initial work, let them rather teach the broad unbiased truths of military and naval history, let them create an understanding of the national and international problems of the day, let them face the issue squarely, so that an educated public, educated to the truths that bear upon national life and honor, shall intelligently and bravely, without complaint or fear, knowing full well what it does, but forgetting self, offer sacrifice, if need be, for what in truth for us is and shall ever be the greatest country in the world.

#### THE ECONOMIC AND STRATEGIC VALUE OF THE LINCOLN HIGHWAY AS CONSIDERED FROM THE STANDPOINT OF NATIONAL DEFENSE

BY AUSTIN F. BEMENT

SECRETARY OF THE LINCOLN HIGHWAY ASSOCIATION

NATIONAL preparedness for defense is the question of the hour. Public attention has been diverted to this topic by the press and every other agency for the securing of the nation's attention for many months. Undoubtedly it will be the greatest point at issue in the national presidential campaign of 1916. Yet it is not essentially a question of politics, and for this reason has secured the greater interest which is being given it. We are hearing more to-day about the condition of our national defense or lack of defense, and about our army, our navy, and their needs, than at any time since the Spanish-American war. Every point at issue has been argued and re-argued from every standpoint, with the result that the average man's interest in and knowledge of the subject is perhaps greater at this time than at any other time in the history of the country.

Certainly national defense has never secured so thorough and wide an attention as since the outbreak of the European war, and yet in all the discussion of the matter, and it is almost impossible to pick up a daily paper or magazine without finding one or more articles on the

subject, the question of roads from the standpoint of national defense is conspicuous by its absence. Yet the good road has played a most important part in the present European conflict, and its necessity in any plan of national defense is apparent to any student of the conditions which underlie modern mobilization, concentration and military strategy in general.

Brought face to face with the question of national preparedness, we have no more important factor to consider from an economic and strategic standpoint than the development of our road system. In the abstract, this subject is too broad for brief consideration, but no better concrete example can be considered than that of the Lincoln Highway extending from New York to San Francisco, and in considering this road from the standpoint of national defense, it may be considered that we are presenting facts and figures which may be applied to any through, connecting road in this country, or to the country's system of roads as a whole, if we assume that such a thing exists.

The attention of the nation is being called to our facilities and lack of facilities for defense by some of the most learned students of the question in the country, both civilian and military. It is only natural that public interest in this vital question has grown daily as events in Europe have forced upon our attention the costly lessons of modern warfare and the penalty a modern nation pays for unpreparedness. Not the least forceful of these lessons is the necessity for proper means of transportation of men, supplies and artillery by other and more flexible means than by rail.

The rapidity of events which has characterized the present European conflict has been bewildering, due to the extensive use which has been made of the motor-propelled vehicle. So extensive, in fact, has been this use that the present war has been called the motor war, and will doubtless go down in history as such. The cinematographic rapidity of mobilization and concentration by the belligerent powers, reveals the years of scientific preparation which made it possible—preparation of means as well as men.

The rapid movement of troops from frontier to frontier, the swift concentration of forces at needed points, the speed with which maneuvers have been executed, have forced a new system of military tactics, and bring out in a way which has impressed the most thoughtful of our economic students this lesson which we in America need above all others—the importance of roads, good, through, connecting highways, in any plan of national preparedness for defense. They are a necessity at any time, and for a hundred reasons, but we will consider them from the phase to which we have limited ourselves—that of preparedness—and we will consider them in a comparative way with those of the belligerent nations across the sea.

It is certain that England could never have mobilized nearly 100,000 men in 24 hours, as she did in the fall of 1914, over the roads we call "good." To do it she had at her command 150,908 miles of improved public thoroughfares upon which she spends the sum of \$40,000,000 each year in upkeep. And these are roads in a country the area of which is less than the state of Florida. Germany could never have massed and hurled her troops at the Belgian frontier over the highways to which we are accustomed. But Germany has 36,000 miles of state road in the best of condition, and in Prussia alone, it may be noted, \$36,000,000 a year is spent in keeping these highways in the best of condition.

In Europe the strategic value of the good road has been too often impressed upon the people by the terrors and bloodshed of actual warfare. If for no other reason than their necessity in the movement of troops, the roads of France, England and Germany would be kept up to the high standard which has characterized them for half a century. It is unfortunately true that their peaceful uses seem to be considered incidental.

The development of events in Europe, however, has given us cause to stop and consider our own facilities for transportation. It is to our interest and profit in this connection to compare our possibilities of rapid concentration and movement with the records for efficiency and speed which the past eighteen months have established. The precedents for comparison at our command are relatively few. The entire range of the activities of the Revolutionary war covered a territory less in area than that of the state of Pennsylvania. Yet we know of the hardships suffered by the colonial troops. As we turn the pages of any authentic history of those stirring times, we read again and again of the exhaustive struggles of the men on the long marches. It is difficult for us to conceive at this day the extent of their struggles, but it is a certain fact that these troops suffered untold tortures and endured the greatest of hardships in merely crossing New Jersey, or in marching a few hundred miles in Pennsylvania—a trip which we can make today in a few hours' riding. We can drive by motor to the beautiful chapel which marks the spot where Washington and his men endured the hardships of the winter of 1778, and in so doing, it is doubly hard to believe that we cover in a few moments of comfortable riding the very stretches which meant hours of painful marching to the exhausted continental army. Wherein lies the difference? Not in the motor which would have been useless on the highways of Washington's time. The difference lies entirely in the roads. Had Washington had our present eastern roads over which to maneuver his men, the historic result might have been even more quickly accomplished.

A more modern instance is brought to our consideration by the

events of the civil war. The great rebellion in actual scope covered less territory than is comprised within the boundaries of the state of Nebraska, and yet the terrors of its marches, with men dropping by the roadside with exhaustion or struggling ankle deep in mud with their shoulders to the wheels of heavy artillery which the spent horses could no longer move, are still vividly remembered by the men who survive. There is, indeed, room for comparison here in the ways and means of economic preparedness, but they are insignificant when held up to view beside the events and possibilities of to-day.

The Spanish war furnished an example of confusion in the lack of preparedness and proper facilities, for the movement of our men and supplies with which it is certain our country would be confronted even yet in time of need. This conflict is our only real basis for comparison with conditions such as those with which Germany and the Allies have been confronted, and it pales to insignificance in comparison with the greater conflict now in progress. Much as we regret to acknowledge it, it must be admitted as a fact that our transportation facilities were so inadequate that thousands of freight cars filled with drugs, food, clothing and supplies laid in the railroad yards for weeks and months in such confusion and congestion that the only way of determining the contents of a car was to break it open, and, at that time, the movement of American forces was for the purposes of invasion; there was no menace to our shores, no men were required along our borders, speed of movement was not so essential. Despite the fact that our coast lines were unprotected, they were in small danger.

The latest instance afforded us for the purpose of comparison was the mobilization of regular troops on the Mexican frontier during the administration of President Taft. This was done in an orderly way, but it was a leisurely movement of a comparatively small body of men. The railroads were sufficient.

A misdirected patriotic conception is responsible for the generally accepted thought that millions of men would respond to the call to arms in case of necessity. Accept this as a fact, and we have yet to consider the most serious phase of national defense. Ours is a country of vast area. Its seaboard coasts are thousands of miles apart. It takes no stretch of the imagination to picture the confusion of traffic of any great number of men, whether in Chicago, Detroit, New York, Buffalo, Philadelphia or other central points, in their endeavor to get to the point where they were needed. No authority of statement has ever been voiced that our railroads would be sufficient. It would be a physical impossibility to put even 100,000 men on our western coast inside of a month even without considering the supplies necessary for such a large body. Six railroad lines that can really be called trans-continental, none of them doubletracked through to the coast, would

constitute our only connection with the Pacific coast, should foreign attack be concentrated there. It would take a month to take even a relatively small number there by way of the Panama Canal, and we have none of the marine facilities to be used in such an emergency in transporting men by sea.

The next thought is roads. A system of good roads, even one good road between New York and San Francisco—the strategic value of a completed hard-surfaced, broad, smooth and straight Lincoln Highway from coast to coast—can not be overestimated. Over it without delay we should be able to transport by motor all the men with their accoutrements necessary for the defense of either coast against the inroads of an invading army. There are two million automobiles in the United States to-day, an ample number of which could be placed at the instant disposal of the government at such a time. In one city of the United States last week there were manufactured over 10,000 automobiles. In one month the number manufactured in that city would provide sufficient cars to place an army of 100,000 men on our Pacific coast in from 12 to 15 days. One hundred thousand men, with all their equipment, crossing 3,400 miles in less than three weeks to the defense of their country—it would be the greatest military exploit in the history of the world. It could be done. The United States produces every day more automobiles than the combined factories of all of Europe and the rest of the world can turn out in a month. Given two weeks notice, and more than 50,000 motor cars could be placed at the disposal of the United States War Department. Put only two men to the car, fill the tonneau with food and ammunition, and with 75 feet between the headlights of one car and the tail light of the next, the first would be pulling into Chicago when the last was leaving New York City.

Such a plan is not the mere impractical visioning of theoretical dreamers. It is the result of technical knowledge and far-sighted ability of some of the best military and civilian authorities of the nation, who can not and have not disregarded the lesson which the events of the past eighteen months in Europe have impressed upon the world.

World conditions and war conditions have changed mightily. In no previous conflict of the world's history have we read of a battle line 500 miles in length, or of armies of millions. The facilities for rapid movement and flexible maneuvering of large bodies of men have made wonderful progress in the last few years. We gasp at the rapidity and precision with which great armies of from one to four million men have been mobilized and moved—at the ease with which heavy artillery, guns of a caliber never before movable have been rushed from one battle front to another—but we can not disregard the fact that at the bottom of all this efficiency, of this rapidity and precision of movement, lie the hundreds of miles of good roads which cover Europe like a network.

It is hard to secure for publication or public quotation the real opinions of any of the officers of the United States army on a question of this kind, for obvious reasons. The officers of our national guard are not so hampered or restricted, and the following excerpt from a letter I recently received from Major John F. O'Ryan, division commander of the New York National Guard, will express, I believe, the opinions of the majority of the military officers of the United States forces:

The value of a coast-to-coast highway, such as the Lincoln Highway, is self-evident from the military point of view. Motor transportation has been developed so rapidly during the past few years and there are now in use in all the states in the union so large a number of commercial trucks, that they constitute an important factor in any problem involving the transportation of men and supplies within the continental limits of the United States in time of war. It may be safely assumed that this wonderful development in mechanical transport of motor transportation will each year have an increased value.

The efficiency, however, of motor transportation is largely dependent upon the character of the route over which the vehicles operate. It is the experience of every motorist touring in this country that the good roads over which rapid progress may be made with safety are unfortunately separated from other roads of like character by miles of wretched country road, and that the good time made in traveling on the former is frequently neutralized by accident and delay superinduced by the latter. It is this "crazy-quilt" pattern of road-making which lessens the value of good road work in the United States so far as military uses are concerned.

The Lincoln Highway project, when completed, will avoid this objection throughout the entire length of the immense travel zone which it will traverse. Few civilians realize how inadequate the great railroad systems of this country would prove for immediate concentration of large military forces with all their horses, mules, wagons, camp equipages, impedimenta and supplies.

The availability of a highway such as The Lincoln Highway would permit its use by fleets of motor trucks carrying supplies, the effect of which would be to relieve to that material extent the pressure on the railroads, and permit the transportation of a greater number of troops in a given time.

Certainly the project would appeal to military officers whose studies force upon their attention the value of time in a defensive operation.

The European war should teach this country more lessons than one. It has brought home emphatically our need for a more adequate national defense. This is a federal consideration. It *should* bring home one of the most obvious and one of the most needed of the lessons—that of good roads—which at present is in this country a state question, a county question and a local question, and one in which every voter should take the most intense and personal interest. We do not have to wait for Congress to provide us with this great aid in an adequate scheme of national defense. We know that roads are an investment and pleasure in time of peace, and a tremendous aid in the transportation of manufactured products and farm produce. We know that they lower the cost of transportation, and thereby lower the cost of living,

and we have had proved to us that they are a necessity and a wonderful aid and defense in time of war.

Let the nation concentrate upon the rapid movement and completion of our main, through, connecting thoroughfares. The Lincoln Highway is the backbone of any national road system in this country. The efforts of the people as a whole should be concentrated upon its permanent completion in hard-surfaced material. The people immediately along the route of the Lincoln Highway realize the tremendous advantages of this road, and their appreciation of these advantages has been shown by the expenditure of over three million dollars in road construction and improvement on that route since its announcement and dedication in 1913.

But the meaning of this road as a connecting link between our two coasts, as a national defense, as a first great object lesson to the people of the country as a whole, should be realized in Maine and Florida, Texas and Oregon, as well as in the states through which the route actually passes. The Lincoln Highway is a *national* road. It should secure national support. Already the force of its example has resulted in hundreds of paralleling and bisecting routes of through travel which, with their branches and countless sub-branches, will eventually cover this country with such a system of roads as has enabled Germany, France, England and the other European belligerents not only to rapidly mobilize their troops for defense or effective offense, but to transport in times of peace the food produce of their farms, and the manufactured products of their countless industries at a cost per ton from one fifth to one twenty-fifth of the American cost. The gigantic sums wasted every year in transportation in this country alone would provide us with a dozen transcontinental, hard-surfaced highways as the foundation for national defense, and a national prosperity hitherto unequalled.

We have no immense standing army, and many question the advisability of one. We have few forts. Our coast defenses are limited, and would be practically impotent against a general and concerted attack. This is admitted by no less an authority than the secretary of war, and has been brought to the attention of the nation by the reports of the general staff. Our navy can be at but one place at a time, and we have the longest coast line of any nation in the world. But give us the means of putting men in great numbers upon either coast with facility and dispatch, give us the means of organizing, mobilizing and transporting our vast citizen soldiery, give us the Lincoln Highway completed, hard-surfaced, connecting the metropolis of our east coast with that of our western shores, give us a system of roads in the United States such as Europe can boast, and our boundaries are as safe as though they were bristling with forts and 18-inch guns.

Abraham Lincoln has said:

With malice toward none, with charity for all, with firmness in the right as God gives us to see the right, let us strive . . . to do all which may achieve and cherish a just and lasting peace among ourselves and with all nations.

The great war president longed for peace, and it is appropriate that the greatest peaceful work of our people as a whole—a tremendous highway uniting a nation in the bond of brotherhood—should also be a great national defense against war, giving us the means of preserving the peace of our people and the tranquility of our homes against all nations, as well as being a most stupendous memorial conception to the honor of Lincoln.

It has remained for the European war and its bloody lesson of unpreparedness to bring out in an emphatic way another and hitherto disregarded reason why we should unite as a nation in pushing through to completion the Lincoln Highway and its connecting roads.

#### AGRICULTURAL EFFICIENCY A FOUNDATION FOR NATIONAL DEFENSE

By HOWARD H. GROSS

PRESIDENT OF THE TARIFF COMMISSION LEAGUE, CHICAGO

AGRICULTURE was not only the first, but it is the greatest of the world's industries. One of the sons of our first parents tended the flocks, while the other one tilled the soil. From that day to this, agriculture has led in the advance of civilization, and its status is practically an index of it. The principal needs of mankind and most of the wealth of the world come from the upper two feet of ground. No nation of large area ever became great and remained so that did not feed its people from its own soil. It is a matter of history that the neglect of agriculture marked the beginning of the end of the Roman Empire. One of the highest duties and principal safeguards of any country is a provision for a sure and inexhaustible food supply, and this, if possible, should be produced within its own borders. In our opportunity to do this, we are fortunately situated. God's best physical gift to man is a fertile land that is spread unevenly over a portion of the earth's surface, and of which we have a generous allotment. It is our duty to use and not abuse this great heritage.

In the early days of the republic, when there seemed almost as much fertile land as sky, we were prodigal in the use of the soil, we abused our birthright, and for a hundred years, spreading from a fringe on the Atlantic coast to the golden sands of the Pacific, we have been depleting our soil by one of the most prodigal, wasteful methods of agri-

culture ever known. Fortunately, our people awakened to the danger, and they did it none too soon. Far-seeing men, more than a generation ago, became alarmed at the trend of agriculture. It became apparent that something must be done. Growing out of this, the first notable step was taken in the passage of the Morrill Act in 1861, establishing agricultural colleges by land grant. This was succeeded by other acts of Congress, such as the Hatch act, the Adams act and the Nelson amendment, which have amplified and strengthened the colleges, created experiment stations, and, through these, a vast body of knowledge has been created relating to the subject of agriculture, the intelligent application of which makes it literally possible to make two blades of grass grow where one had grown before, and to make grass grow in localities where it never had grown before; and at the same time to build up the soil to even greater fertility. No greater work for our country could possibly be done.

The latest and probably the most notable enactment ever made by any government for the advance of agriculture and civilization was the late Smith-Lever agricultural extension act that came into operation July 1, 1914. In referring to this act, the distinguished Secretary of Agriculture, in his report for 1914, says:

This measure is of vast significance. It is one of the most striking educational measures ever adopted by any government. It recognizes a new class of students, a class composed of men and women working at their daily tasks on the farm. The federal and the state governments take the adult farmer and the farm woman, as well as the farm boy and the farm girl, as their pupils. The measure provides for cooperation between states and the federal government, it guarantees a coordination of the forces of the two jurisdictions, it places the plans of the two great agencies in conjunction, eliminates waste and friction and insures efficiency.

Good judges are in agreement that the logical sequence of this great enactment, supplemental to those going before it, is that the great industry of agriculture will become more profitable to the man upon the soil and more interesting to his children. It means a redirection of agriculture upon scientific lines. It means efficiency, it means a higher and a better civilization. It will help build up our rural communities and, without doubt, will serve to check the enormous drift from the country to the city. This was the result of the application of a plan less perfect in Western Europe. It will do much to stabilize our industries and enable us to weave a strong industrial fabric without which we could not hope to reach a high degree of national efficiency.

Should we ever be called upon to defend our national honor or existence by force of arms, our strength and our ability to do so successfully must rest upon our ability to respond to the nation's need in food and wealth as truly as with cannon and battleships. Even with a low average acre yield, the total value of the output of our soil from all

sources is approximately ten billion dollars per year, a sum so vast that the mind can not grasp it. The Dutch Commissioner of Agriculture told me, while driving over Holland and discussing the progress that had been made in his interesting country, that, in his opinion, the Smith-Lever enactment was the greatest piece of constructive legislation in all history. He remarked: "You have now approximately one hundred millions of people and in fifty years, if you go on with your wonderful progress, you will have two hundred millions." Our yield of cereals per acre is less than that of Western Europe, so we have a wonderful opportunity to increase our production, and those in a position to judge best agree that it is conservative to assume that within ten or fifteen years at most the value of our soil output will have increased at least fifty per cent., or an annual increase of wealth of five billions of dollars. This colossal sum is five times greater than the combined capital-stock of all the national banks in the United States, and is twice as great as the combined earnings of all the railroads in the land. Thus we see that the future holds for us a great opportunity. Shall we measure up to it?

The destruction of life and property in modern warfare is appalling. It is no longer a battle of men, but a conflict of machines and chemicals. God grant that we soon reach a point in the world's civilization where differences between nations will be adjudicated on the basis of moral right instead of physical might. But until that time shall come, it is essential that every nation should be prepared to defend itself against any aggressor. While we are comparatively isolated from the world's troubled centers, I believe we are facing a situation of grave peril. This awful conflict in Europe in eighteen months has caused a money waste, aside from the destruction of public and private property, that approximates the startling sum of forty billions of dollars. This colossal figure represents an amount practically equal to the cash value of all farm property in the United States.

This conflict must end when human endurance has reached its limit or cash and credit have been exhausted. In the aftermath, democracy will be put to the supreme test. Our own country will remain as the world's money center and will be the chief creditor nation of the world. Our wealth will excite the envy of all the nations, and with a storehouse so overloaded with the good things of life, it may be a temptation to those nations that have suffered so severely, but that are yet strong in army and navy, to insist upon some readjustment of the world's wealth. Are they not in a position to enforce such a demand upon us as matters now stand? I am not an alarmist, but our situation is such that it demands immediate and patriotic consideration by every thoughtful citizen.

The world is amazed at the wonderful resourcefulness, strength and

efficiency Germany has shown in the last eighteen months. For the solution we have not far to go. It lies in the fact that thirty years ago the Empire began a systematic and scientific development of all its industries, including agriculture. The government assumed as its duty the correlation and direction of the industries and the development of its resources, and it has done so until they have reached the highest standard of efficiency that has so far been attained. Their handling of the tariff is a lesson to the world. In dealing with this subject, the purpose from the first was not to build up individual and favored industries, but to strengthen the Fatherland. The tariff was handled along scientific lines and every industry was given due consideration. On the other hand, this subject with us has been a question of pull, politics and favoritism. If the unnecessary economic waste that our method of dealing with the tariff has brought upon us for the last thirty years could be totaled, the amount would be appalling. Germany's science, Germany's forethought and industry has enabled her to weave the most wonderful industrial fabric the world has so far known; and this is the foundation that is now supporting the mighty military burden she has been and is now subjected to. One of the notable phases of preparedness of Germany was the success in handling her agricultural resources, providing food and supplies within her own borders.

Covering the general question of efficiency and preparedness, there are two phases of the subject—the preparedness for war and the preparedness for peace. In the one, we make provision to defend our land from physical invasion by enemies, while in the other, the necessity is the protection of our industries and our commerce. Thus preparedness for us has a double meaning, but in both of these agriculture plays a leading part. If I were asked to state in a word a summary of the whole situation, it would be that scientific accuracy must displace guess-work; that the administration of the government must be for all the people and that the common good must be the paramount consideration; that the politician must go and the statesman must appear.

The bane of democracy and its greatest menace is subverting every issue to consideration from the angle of party politics instead of that of statesmanship and general welfare. The concept is that, like love and war, all is fair in politics, and that politics must dominate public business. It is not an exaggeration to say that at least one half of every dollar raised by taxation is wasted by the grossly inefficient way in which public business is done. Many well-informed persons know, and I think most of us believe, that if the hundreds of millions of money appropriated for defense could have been wisely expended under the direction of expert advice that we have had from our army and

navy boards, we should at this time have been in a position where a strong defense could be made against any attack upon our coast line and give us a sense of security that in these troubled times we can not now feel. We are approaching a world's crisis, which will come as an aftermath of the awful war. It is exceedingly important that no time be lost in preparing to meet it, both from the angle of a possible war and (no less) from the angle of a certain peace and the readjustment that must follow it.

In view of the seriousness of the future that confronts us, it is nothing less than a crime to permit pull and politics to have any influence whatever in bringing our country to the best possible position to meet any crisis that awaits us; and any man who insists upon continuing to play politics should be denounced as a public enemy. There is no subject that it is more important to take completely out of the domain of politics than the adjustment of our tariff. It is the one effective means of raising revenues and protecting our market from becoming a dumping-ground for the rest of the world. As matters stand to-day, the United States is the one great cash market. It is the world's largest consumer and its means are ample. A suggestion has been made that the government should, through the Department of State, have the consuls deal with the matter of importations and if they found that the goods offered would demoralize our markets, they might withhold their consent and prevent shipments. This would be an unusual and extraordinary measure. Would these government agents be in a position to accurately determine the issues? Would not foreign countries resent such drastic action? Would it not be regarded as gratuitous and unwarranted? It would create no end of friction and would probably result in long and vexatious delay and, possibly, international complications. We have reached the time when we should endeavor to make friends abroad, instead of enemies. The best plan is to follow the custom and deal with these questions through the usual channels of tariff legislation. Before we go far, we shall undoubtedly find it expedient for Congress to fix maximum and minimum rates, with a wide margin between them, and authorize the president, on the recommendation of a real, bona fide, non-partisan tariff commission, to put such rates of duty in force as the exigencies of the case may demand from time to time, subject, of course, to review by Congress. To any thoughtful man it must be apparent that membership upon such a commission is a man's job, and the body charged with this duty should have nothing else before it. Dealing with the tariff in this manner will ultimately remove it from political controversy, will stabilize business and give us tranquility where now we have turmoil.

## PEACE THROUGH NATIONAL DEFENSE

BY ANNE ROGERS MINOR

WATERFORD, CONN.

THE war in Europe, terrible and hateful as it all is, is awakening a new patriotism in the United States. We see clearly the weakness of our position when forced to make demands of other nations. We see our almost defenseless coasts, our slow-growing navy and our very inadequate army. The grim realization of these facts is forced upon us, and we now know it would be criminal for us to persist longer in our traditional policy of unpreparedness and ignorance—a policy which has continued from the beginnings of the republic and which cost us more in blood, treasure and needless war than anything else in our history.

The people of the United States want peace, and we look for some method of assuring ourselves not only of the continuance of the peace which we now enjoy, but more than that, for the acquisition of power to help promote peace in other nations. We want national defense not for war, but to promote more perfect peace. It was a soldier, William Tecumseh Sherman, who said: "The legitimate object of war is more perfect peace."

How are we to maintain that peace which we have long enjoyed, that peace which is the highest ideal of our national life and without which we can not preserve the free institutions which our forefathers fought to establish? How are we to help to promote peace in other nations without the strength to make our protests effective. The answer is national defense, or power to enforce peace. In other words, that power which inspires such respect for us in other nations as will forbid their attacking us. No truer words were ever spoken than these of Bayard Taylor's "Peace the offspring is of Power."

Up to a little more than a year ago we did not believe that such a war as is being waged in Europe to-day was possible. We had hoped that war between civilized nations was a thing of the past, but our hopes were suddenly blasted when the most enlightened nations of the earth were caught in the same passions of war as the veriest savages, less indiscriminately cruel perhaps, but just as blind in their frenzy of patriotic love and hate. These events have proved only too clearly that, no matter how highly civilized nations may appear to be, when their national safety seems at stake, or their national interests menaced, civilization and restraint are thrown to the winds, treaties and compacts are forgotten, whole races spurred by sudden savage hatred plunge headlong into war to the death with other races whom they hailed a short time before as friends and brothers. In the light of these facts, it is folly to say that war and aggression are things of the past, and that na-

tional humility and confidence in our own good intent, and in the high moral civilization of our neighboring nations, are sufficient guards against attack and disaster. We must profit by the lessons from the battlefields of Europe and not allow the futile and emotional cries of theorists and reformers for "peace, peace when there is no peace" blind us to the stern facts and realities which confront us and threaten not only our peace but our national existence.

A no doubt well-intentioned, but misguided, movement is being agitated among us which threatens to sap the strength of the nation and if not arrested bids fair to rob us of many of the sturdy qualities which are the mainstay of the republic. I refer to pacificism or the theory of "peace at any price"—a doctrine of absolute non-resistance. We must remember that we should not exist as a nation to-day if the men of '76 had believed in this theory. If carried to extremes it would amount to no less than treason in hours of national peril. When ordinarily sensible and high-minded people say to me that, even if an invader should approach our shores, we should let him enter and take possession, that we should offer no resistance, but allow him to violate our sacred liberties, I am lost in bewilderment at the kind of mind or soul which seems so lost to the fundamental instincts of self-defense implanted in the whole animate creation. Are we to put our faith in peace ships while the doctrine of brute force, the self-acknowledged creed of one great nation that "Might is Right" still stalks abroad in the world, leaving its trail of blood and death on the fair fields of Europe? Shall we put our faith in peace ships when the ships of militarism cross the ocean and train their engines of death on our defenseless shores? God forbid that any such sentimental folly should ever replace the spirit of America, the spirit that made us a nation, the spirit that actuated the men of Concord and Lexington and Valley Forge. To imagine such a possibility is an insult to the memory of those patriots who sprang to the defense of their home-land against tyranny and outrage; an insult to their brave wives and daughters and sweethearts who bade them go in God's name, and then did men's work at home that the nation might live. We see this spirit to-day in the women of France, yet there are those who dare to summon them to talk of peace in conventions, while their homes are burning and their land is devastated and their husbands and sons are slain by the ruthless god of "Might is Right." What they want now is not "peace at any price." They want the kind of peace that can never be broken again. Is pacificism likely to bring this about? Can pacificism stay the onward course of a triumphant militarism armed to the teeth? Could pacificism have helped Belgium in her hour of horror and need? Is it a man's part, or a woman's either, for that matter, to stand by idly theorizing, while the strong attack the weak, and treaties are proclaimed

to be naught but scraps of paper? What constitutes the binding force of a treaty in the mind of a nation that can so regard a treaty? Obviously nothing but a gun, since agreements and promises mean nothing. Insidious and secret war is already being waged upon us, a neutral nation, within our own borders by conspirators and spies to whom treaties and honor mean nothing. Our peace is threatened, our right to pursue our industrial interests undisturbed has been violated; our right to travel the high seas is denied; and American lives are sacrificed; internal disorders and lawlessness are instigated by the same power that trampled defenseless Belgium under foot. What are we going to do about it? After nine months of silence we uttered a protest against the slaughter of our citizens at sea and the violation of every sentiment of humanity and civilization. "What are you going to do about it?" was the reply, as plainly said as though uttered in words, and then the Arabic was sunk. We were told to keep off the high seas, where we have a right to go in pursuit of lawful business; we were told to keep from taking passage on ships of belligerents, even though they were innocent merchantmen, so that violations of international law and humanity might go on undisturbed. And pacifists would have us keep off, and continue the policy of polite letter-writing, while more innocent lives are sacrificed to the god of Might-is-Right. If we had had something besides ink to feed the power of Mr. Wilson's pen the results might have been different. But we had not and Germany knew it. "The pen is mightier than the sword" in all cases except—that of a scrap of paper. If human liberty, civilization and self-government go down to final death in the trenches of Europe under the assaults of militarism, will a defenseless pacificism save us from a like fate?

Pacifists tell us they do not mean disarmament, but they do mean that we should not increase our present total inadequate defenses.

Disarmament would be a splendid thing under certain conditions; it is what we all want; but to be effective it must be universal and simultaneous. We believe that through national defense this dream of disarmament will eventually come true. It is not true now, and until mankind reaches a stage of development that will admit of complete disarmament, our only safety lies in increasing our defenses.

There is no equality between one man armed and another man disarmed, and so it is with nations. Stable and equal conditions of peace can exist only between equally armed nations or equally disarmed nations, such as the United States and Canada. But between armed Europe and an unarmed America there is no equality and therefore there can be no security of continued peace. In the midst of the raging "sea of war" in Europe to-day there is what has been well named a little "island of peace." This is the wonderful little nation of Switzerland, respected, untouched, inviolate. And why? Because she is a

nation armed to the teeth—every citizen a trained soldier. She is equal to her armed neighbors, yet without standing army or militaristic methods. Opposed to militarism, on the one hand, as strongly as she is opposed to "peace at any price" doctrines, on the other, she nevertheless maintains herself in a condition of continued peace even in the midst of surrounding war. While we in America stand around theorizing, and talking of universal peace in conventions and sending out peace ships to ask the dogs of war in Europe please to let go of each other's throats, this little country has turned itself into a nation of soldiers through a system of voluntary compulsory military service—voluntary because the nation voluntarily chose to submit itself to this means of national defense. More thoroughly democratic than we are ourselves, they have nevertheless realized that compulsory universal service is their only guarantee of national independence, and they have had since 1874 a veritable citizen army, in which every able-bodied citizen is a trained soldier and not one, except the general and his staff, a professional military man. To an article in *The National Geographic Magazine* for November, 1915, I am indebted for these facts and for the following figures. With a smaller population than that of Massachusetts and an area twice the latter's size, Switzerland can mobilize 240,000 trained soldiers in twenty-four hours. At the same rate we could mobilize 8,000,000. Besides these men, the Swiss have as many more in reserve, so that under this system we could have in the field a trained army of 16,000,000 men within twenty-four hours. The founders of our country laid down the same idea of a citizen soldiery; the only difference is, the Swiss have put it into serious practise, while we theorize and make laws which we never enforce. In principle, every citizen is supposed to join the militia. Does he? And how many Americans know how to shoot to hit the mark, or have ever handled a gun? As a sharp contrast, the Swiss boy begins at ten years of age to take the gymnastics that fit him for military training, and he learns how to shoot like William Tell—substituting bullets for arrows. Every man cheerfully sacrifices a definite amount of his time toward the maintenance of the one thing dear to every Swiss—as to every American—his independence as a citizen of a free country, and the amount of time is exceedingly little. During the first year of liability to military service at the age of seventeen, he gives up seventy-five days, but only eleven days in each successive year.

His training is in the field, not in drill rooms, and he spends less on military taxes than any other nation. The burdens of preparedness are thus spread over the whole nation, and lie heavy upon no one individual. There are no "crack" regiments; no picking and choosing in the service. Each man goes where he is sent and can serve best. There is no caste system. Brains and ability win the high places;

all start from the ranks. Our militia system has much to learn before it can be compared with the Swiss citizen army of defenders—for defenders they are. Not one foot of territory do they wish to acquire. Not a blow would they strike in aggression, but let him who strikes at them beware what he does! This is the ideal of national defense, which is the inalienable right of every man, of every woman, of every nation to defend itself against attack. Herein lie self-respect and a national dignity impervious to insult, because it is above insult. "Though surrounded on all sides by belligerent millions" (to quote from the aforesaid article) whose interests might be served by asking her to step out of their path, Switzerland to-day stands an island of peace in a sea of war, because she has prepared to maintain her neutrality and her freedom, or at least to exact such a price for them that none of the nations at war can afford to pay for their violation." What an object lesson for us. While in a country so large as ours it would be the height of folly to give up our regular standing army—say rather, it should be increased—it ought to be practicable to so remodel our militia as to approach nearer to the wonderful efficiency of the citizen army of Switzerland. If to such an army we would but add an adequate navy and sea-coast defense, we should be invincible. This would not militarize us as a nation; it would train us simply in efficient self-defense, whereby alone we can inspire, respect and maintain peace and liberty.

Therefore to secure peace for our own country in years to come a policy of strong national defense is necessary until such time as the probability of war is reduced to much below the present ratio.

We believe that it would be just as unwise for the United States to allow its army and navy to deteriorate, as it would be for a householder to allow the fire-insurance policy on his house to lapse because he disapproved of fires and hoped there would be no more of them! One of the fundamental laws of our government—of any government—is the protection of persons and property and it should be our national resolve to be strong enough to protect the weak from the aggressions of the powerful who are also unscrupulous, and the innocent from the violence of criminals, whether individuals or nations.

It is not sufficient that this country should merely defend its own citizens; it must, as it did in those first years of the nineteenth century, take its share in the burdens of maintaining law throughout the world. "Man lives not to himself alone" is as true of nations as of individuals. Government is organized defense of others. The nation that will not protect its citizens at home and abroad has no right to the name of nation for it lacks the essentials of government.

One reason why Americans have a right to be proud of their nation's history is that in the earliest days of its life, when its population was

small and its resources limited, the United States showed itself willing to sacrifice blood and treasure for the protection of the rights of its citizens. Against England in 1812 it set itself for the sake of defending the freedom of the sea,

Still earlier in its history, when it had many domestic difficulties to contend with, it undertook to rid the Mediterranean of the Barbary pirates who infested it. You know the results. Should we not now, when we are large and rich and strong, protect our own citizens on the high seas and be able to take our share in the burdens of maintaining law throughout the world? It is a plain duty that we should; and if we are to take our full part, we must have the means by which to take it. The disorderly and lawless are not quelled by words or diplomatic notes. We must have some method of establishing justice and some means of defending justice with arms. The American people must not be content until this nation is fit to take part in the world's work, and all patriotic Americans should unite in insisting that we have adequate national defense. As descendants of the patriots of the American revolution, we owe a distinctive duty to our country to uphold our institutions and our national dignity and to stand ready at all times with the spirit of highest patriotism to guard and protect our rights and privileges and that liberty for which our ancestors fought. National defense was the keynote sounded by Washington when he said "To be prepared for war is the most effective means of promoting peace," and he further said:

There is a rank due the United States among nations which will be withheld, if not absolutely lost, by the reputation of weakness. If we desire to avoid insult we must be able to repel it; if we desire to secure peace, one of the most powerful instruments of our rising prosperity, it must be known that we are at all times ready for war.

Another patriot, Charles Pinckney, voiced the same spirit of defense when he said:

Millions for defense but not one cent for tribute.

President Wilson expressed his views on national preparedness a few weeks ago, when he said:

I would not feel that I was discharging the solemn obligations I owe to the country were I not to speak in terms of the deepest solemnity of the urgency and necessity of preparing ourselves to guard and protect the rights and privileges of our people, our sacred heritage of the fathers who struggled to make us an independent nation. Come, let us renew our allegiance to America, conserve her strength in its purity, make her chief among those who serve mankind, self-reverenced, self-commended, mistress of all forces of quiet council, strong above all others in good will and the might of invincible justice and right.

The war in Europe to-day has awakened in us a new realization of the profound truth of these words I have quoted from Washington, our

first, and from Wilson our latest president. To defend the heritage of our fathers is a sacred duty. The spirit of our fathers calls us like the minute men of old to our country's defense. Not in weakness, but in power lie the foundations of that continued peace which is the highest ideal of a true, loyal and enlightened patriotism.

### IMMUNITY OF MONUMENTS, MUSEUMS, LIBRARIES, ARCHITECTURAL AND HISTORICAL STRUC- TURES IN WAR AND PEACE

By GEORGE FREDERICK KUNZ, Ph.D., Sc.D.

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ENCOURAGING advances have been made in the United States and in foreign countries in the preservation of natural and architectural landmarks in time of peace, but the events of the European war which began the summer before last have emphasized in a painful way the need for some international agreement which will secure the immunity of historical monuments, museums, libraries and works of art generally in time of war. If the civilized nations of the world have not yet so far outgrown their primitive passions as to be able to settle international differences by means other than slaughter and destruction, it would seem practicable to mitigate at least the losses of war by preserving historical monuments, cathedrals, civic buildings, libraries and works of art. The existence of these in no way affects the fortunes of war, but their destruction robs civilization of the evidences of its progress, obliterates forever the products of the genius of former generations, and causes the animosities engendered by the war to rankle in the hearts of men for generations to come.

In any war, the greatest destruction in these respects is naturally inflicted in the country invaded and by the invaders. People do not destroy their own treasures if they can help it. It therefore happens that in the present European war, Belgium and France have been the chief sufferers, and in a lesser degree the Polish provinces and even England. But it is not intended by this statement to imply that the invaders in the present case are more ruthless than other nationalities have been in the past. In the conflict between Italy and Austria, the destruction of Görtz or Goritza, and the damage done by bombs in Venice offer a sad reciprocity in the infliction of useless injury.

The history of the famous Alexandrian library is sufficiently polyglot in this respect. Part of the library—the largest in the ancient world, embracing the collected literature of Rome, Greece, India and Egypt—was destroyed by fire during the siege by Julius Cæsar. Another

part, kept in the temple of Jupiter Serapis, was largely destroyed when Theodosius the Great permitted the Serapium to be demolished with all other heathen temples in the Roman Empire, A.D. 391. What the Christians left, the Arabs, under Calif Omar, obliterated in 641. Of the books in the Alexandrian Library Omar is alleged to have said:

If these works agree with the Koran they are unnecessary, if they disagree they are heretical; therefore let them be burned.

Diocletian's destructive inquisition in the east left few Christian books for Constantine to collect at Byzantium; and after the inroads of the barbarians into the Roman empire, the ravages of fire and war had destroyed practically everything that could be called a library.

The burning of the Arabic manuscripts in Granada by Ximenes, and the holocaust of the colored picture writings of the Aztecs in Mexico by Zumarraga, obliterated irretrievably valuable records connecting modern and ancient history.

The almost total destruction of Heidelberg by the French troops in 1639 and 1693, with the loss of many literary and art treasures, and the destruction of the valuable public library of Strassburg during the German bombardment in the Franco-Prussian war of 1870, are more modern illustrations of the fact that the ravages of war in this direction have not been confined to any one nationality.

The present is not an appropriate time to review the destruction caused by the European war now raging. When the war has ceased and the field has been surveyed, so that the facts can be accurately ascertained and dispassionately judged, we shall know the true measure of what Liège, Louvain, Rheims, Whitby, and other places have suffered and what art, letters and history have lost in the making of a new epoch in the history of human events.<sup>1</sup>

It is sufficient now to call attention to the public sentiment in favor of restricting this destruction and to express the hope that measures may be taken to prevent it in the future.

At a meeting held at the National Arts Club in New York City on December 4, 1911, the president of the American Scenic and Historic Preservation Society said:

The destruction caused by siege operations when not controlled by the stipulations of an international agreement to protect those treasures of art and literature which should be regarded as international property, since the enjoyment and use of them is freely accorded to all, natives or foreigners, who may wish to avail themselves of the privilege, has been only too often demonstrated.

<sup>1</sup> At a meeting of the German Metallurgists at Düsseldorf, held in February, 1915, Dr. Schuster, speaking of the lack of copper, zinc, and other metals needed in the manufacture of war materials, suggested that the authorities should commandeer, not only in Germany but also in Belgium and France, all available metals from the brass water tap to the copper roofs on the churches, including in the perquisition all bronze monuments.

If, at the next meeting of the Hague Tribunal, an agreement is reached by which libraries and museums will always be exempted from destruction during a war, one great source of danger to the records of history will be removed. It would be most desirable that some such international agreement should be made in regard to the preservation of libraries or museums from wanton destruction in the case of the bombardment of a city. Would that an international understanding of the kind had existed when the Alexandrian library was in jeopardy! Indeed, even as recently as the Anglo-Egyptian war of 1882, the existence and enforcement of regulations for the protection of valuable records might have saved untold trouble regarding land titles, caused by the loss or destruction of legally recorded documents.

During the past year the American Society for Historic and Scenic Preservation has brought this subject to the attention of the Secretary of State of the United States, in the hope that steps might be taken to lessen further losses in the present war, and to pave the way for more effective measures in the future.

In furtherance of this idea, the president of the society has designed a flag to be displayed over churches, libraries, museums and historical monuments, for the purpose of securing for them immunity similar to that which hospitals enjoy under the Red Cross flag. This flag, having a width equal to two thirds of the length, consists of a white field, with a diagonal colored stripe running from the upper corner at the hoist to the lower outer corner, the stripe being in width equal to about one third of the width of the flag. By the color of the diagonal stripe the nature of the protected building may be indicated—red, for instance, signifying a museum, blue a library, etc. Specimens of this flag were displayed at a public meeting of this society held in the American Museum of Natural History in New York City on January 13, 1915.

Action along similar lines has also been taken by the American Institute of Architects and by the Architectural League of New York, as well as by the National Sculpture Society, which has addressed a direct and eloquent appeal to the European belligerents.

A despatch to the London *Daily News* from Brussels, in August, 1914, reported information received from M. Paul Otlet, president of the Union des Associations Internationales, that a movement was on foot to induce the United States to obtain the cooperation of the neutral powers of the world in approaching the belligerents to beg them to respect museums of art and scientific collections in the threatened capitals. He mentioned, for instance, that in Brussels were the plates of the photographic map of the heavens. It has taken twenty years to complete the work, and the destruction of the plates would be an almost irreparable loss to the world.

In September, 1914, the diplomatic representatives of neutral countries asked the Hon. Myron T. Herrick, United States ambassador to France, to sound the American government on the question of making

joint representations to Germany to protect certain buildings and works of art in the event of an attack on Paris.

And from a cablegram to the *New York Times* from Rome, dated January 23, 1915, we learn that, before Italy's declaration of war, a group of well-known Italians addressed a letter to Secretary Bryan conveying an appeal that the United States take some action to the end that the monuments of art in the belligerent countries be preserved from ruin. It was the expectation of those who were launching this movement that it would find support in other neutral states, particularly in Switzerland and Spain. The letter was signed by Bestolfi, the well-known sculptor; by Aristide Sartorio, the painter, and by Giacomo Boni, the archeologist, and said in part:

The art treasures in these countries must be considered as part of the patrimony of the civilized world, and not as the particular property of any country. If all great artists and influential people throughout the world join in this movement much may be done to preserve these art treasures which otherwise will suffer irreparable loss. We look toward the United States as the nation which today, better than any other, can undertake this task and see it through to a successful accomplishment.

In conclusion the writers asked Mr. Bryan to call the attention of the president to the matter.

It is much to be regretted that the regulations adopted by the delegates to the last Hague convention, were not officially ratified by all the governments represented there, as in that case we should have a few hard and fast rules to appeal to, rules which the several nations would feel bound to respect as matters of international law, and not merely of international comity. For the latter, although often operative in time of peace, is but a weak reed to lean upon in time of war.

However, no agreement entered into by the nations to refrain from the destruction of historic monuments and art treasures can ever be of avail unless it be at the same time clearly and definitely understood that such monuments must be equally respected by both belligerents. When this is not the case, when the defenders have yielded to the temptation of utilizing an edifice for military purposes, for signalling or observation, or for masking their artillery, the responsibility for any injury must rest on their own shoulders.

How essential this is has been illustrated by the havoc wrought in the Parthenon through the explosion of powder stored therein by the Turks, during the siege of Athens by the Venetians in 1687. The knowledge that this unique monument of art was being made use of as a powder magazine caused the Venetian fleet to fire upon it, an act that would almost certainly have been avoided otherwise, but one that was quite justifiable under the circumstances, although eternally regrettable. Until that time, this great edifice, erected by the architects Ictinus and

Callicrates in the Age of Pericles, two thousand years before, was still essentially intact.

The thunderbolts of war are not the only perils to tall buildings or lofty columns, for those of nature are chargeable with a number of disasters. At Santamaria di Capua Vetere, in the province of Caserta, Italy, a high column of travertine marble set on a firm pedestal of the same material and bearing a bronze statue of Victory about ten feet high, weighing 1,500 pounds and affixed to the column by an iron rod, had been erected as a memorial of the battle fought near Volturmo in 1860. This monument, about 95 feet high, stood in the quadrangle of the communal building and no trees were anywhere near it; nevertheless, on an October day in 1914, during a severe thunderstorm, a bolt of lightning struck the massive statue, hurling it to the ground and breaking away the upper half of the supporting column.<sup>2</sup> It is believed that had a metallic conductor been passed down from the bottom of the iron rod to a damp sub-soil, the electric discharge would have been carried into the ground, instead of spending its fury on statue and column. The insulating mass of marble afforded no protection, but rather constituted a danger.

In the Constantinople of the Eastern Empire, two columns were wrecked in a like manner, one in A.D. 548, and another, commemorating Constantine the Great, in 1101. A similar fate threatened the column of Marcus Aurelius Antoninus in Rome, when it was struck by lightning in the fourteenth century, but escaped with severe damage to the top; while in the same century the statue of Trajan at the top of the Trajan Column in Rome was destroyed by an electric discharge. In ancient Rome the Baths of Nero, erected in A.D. 60, were destroyed by lightning in the following year. Coming down to the Rome of the Renaissance, the bronze statue of the Archangel Michael on the Castle of St. Angelo, to which it gave the name, and the flagstaff there, were wrecked by lightning in 1572, and from 1606 to 1809 St. Peter's was struck no less than twenty-two times, but no great material damage was ever done. After the last accident Pope Pius VII. had lightning rods installed and for the past century they have proved efficient protectors for this greatest of Roman Catholic churches.

Of other Italian edifices destroyed by lightning, the following towers may be noted: in 1521, that of the Castello of Milan; in 1676, that of Ivren; in 1769, that of San Nazaro at Brescia, and in 1808, the tower of the fortress on the Lido opposite Venice.

The protection afforded against the thunderbolt by the lightning rod may be assimilated to that given by a binding international agreement

<sup>2</sup> This and the following instances of monuments and buildings struck by lightning are reported in a memoir by Professor Ignazio Galli published in the *Atti della Ponteficia Accademia Romana dei Nuovi Lincei*, Dec. 20, 1914.

against the devastating projectiles hurled from the huge guns, the products of human ingenuity and industry. It is to be hoped that when the storm of war has passed away and the nations of the world are again able to take up their interrupted march toward the goals of social, scientific, artistic and industrial progress and aspiration, the terrible lessons taught by the war will not have been learned in vain, but will serve as incentives to provide adequate safeguards for the future. If, as we scarcely dare to believe, an era of peace and good will follows the close of the bitter conflict, the action in common for the preservation of the historic and art treasures of the world will help on the good work.

### PREPAREDNESS—SOME SUGGESTIONS

BY ARTHUR WILLIAMS

NEW YORK CITY

THOSE interested in the preservation of that which connects us with the past in art, literature and architecture, look upon the unnecessary destruction of the museums, churches, monuments and historical structures, that is being wrought in Europe, with a degree of regret and horror which can not be easily expressed. Loss of such buildings as the Hôtel de Ville at Louvain, the Cloth Hall at Ypres, the Hôtel de Ville at Arras, such a marvel of architecture as the Rheims Cathedral, or the destruction of such valuable manuscripts and volumes as those housed by the University at Louvain, are calamities to be lamented in the conservation of art and learning. In New York City alone, who could measure the damage resulting from the destruction of such buildings as those of the American Museum of Natural History, the American Museum of Art, the American Museum of Safety, the New York Public Library and many others? Every one must view with apprehension any condition through which our educational and historical structures would be the subject of possible destruction through the attack of an enemy. This would be particularly so if that calamity should be the result of evident unpreparedness, after all the warnings we have received through the conditions existing in the countries now at war.

A program which is distinctly confined to the defensive side of warfare is not necessarily one which would be immediately capable of an effectively offensive campaign. That is to say, the essential elements in a defensive program, where the clearly defined objectives are defensive, do not necessarily equip one for effective offensive action. Preparation for defense could be utilized for an offensive, and places material at our disposal for an offensive movement much more quickly

than were we without our defensive preparation. But the two objectives are opposed to each other and simply because our country places itself in a position for an effective defense is not a reason to fear that we would more readily be apt to give offense to others or become here, as was the case in Europe, an "armed camp" and a nation of "military men."

Our entire attitude should be one of effective defense, on both land and sea, of each of the states, of our foreign possessions, so long as they remain under our control, and in addition should afford adequate protection to our citizens abroad. The present conditions in Europe show that any failure on our part to provide adequate defense would be most short-sighted and wholly inconsistent with the demands of the country. This is probably the feeling of the great majority of the American people. The conviction can be little short of unanimous that in the last analysis behind any treaty or agreement we must have a military and naval organization of a defensive character that could adequately meet the offensive from any probable or possible enemy or combination of enemies.

Adequate military preparation takes years. This is true not only of ships, guns and other machines, but of human beings, upon whom to the last degree the result must depend. Preparation must include ships of varying degrees, arms and munitions, clothing, housing, equipment and the fullest needs of the commissary and the medical departments. Some of the preparation may consist of a latent ability to produce quickly and well; some must consist of an existing equipment in all of these departments ready for practically instantaneous use.

The seventeen years that have elapsed since the Spanish war have at least partly eliminated some of the lessons of that war. Very few understand the extent to which we were unprepared, even for a power so relatively weak as Spain. Our lack of material then went even so far that the authorities were without cables to mine our harbors, or mines to protect them, or explosives with which to charge the mines. We were without a need so fundamental as search lamps; the government had none, the manufacturers were out of supplies and it was necessary to secure the promise of a loan of such lamps from those who had them. We were without equipment in our commissary departments and the ultimate provisions even were a blot upon the administration of the country; and as for sanitation, even of the most elementary character, no such thing was known in any practical sense.

We were without men for our forts, without men to instruct others how to operate our coast defenses. The available trained men of the army were but a handful, and hundreds or thousands were needed where but one was available. Had our war been with one of the first-class powers, many of our coast cities would have been destroyed and landings could have been effected. That our nation would be conquered by

any country, however great, is not to be supposed for a moment; but that vast properties would be destroyed and hundreds of thousands, if not millions, of men "killed, injured or missing" included in our daily lists before a satisfactory result could be reached, would have been then part of the price of foolish unpreparedness, just as it would be part of the price to-day.

Many plans have been proposed and probably upon no plan do all minds meet. About an adequate navy there seems to be no difference of opinion, except possibly in the definition of the term "adequate." Unless we have a navy equal to that of any other country with which we may be at war, naval equality will be an impossibility, and, dealing with a superior force, certainly, in the absence of miracles, we must concede defeat at sea. Nothing is gained by assuming a strength we do not possess. If our navy is inferior to that of England, the English in the event of war could obtain the supremacy of the seas and our sea commerce would cease. This would be a serious matter only from the standpoint of retaining our foreign possessions and of protecting our commerce. The determining factor here would seem to be whether the country wants to go to the expense of being at all times reasonably sure of holding its possessions and of protecting its sea commerce. Apart from the question of patriotism and national pride, does the one equal the other? In the absence of such adequate provision, we could retain our foreign possessions and our sea commerce only so long as another nation with its own navy, or a combination of nations with their navies, permitted us to do so.

Apart from this question of size, all will agree that the country should possess an adequate navy, whatever may be accepted finally as the definition of this term. Such a navy should include dreadnaughts and super-dreadnaughts, at one end of the line, and submarines and transports, at the other end. One of the lessons of the Spanish war was the necessity for transports and one of the serious difficulties for a time was that of transporting equipment, munitions and men. Transports—a term which here is used as being inclusive of colliers for coaling our vessels at sea or at distant points—may be obtained either through a fleet maintained solely for that purpose by the government, lying idle and depreciating rapidly in times of peace, or by the upbuilding of a large merchant marine through private resources, as in England, which would be immediately available for the needs of the government in the event of war. Those who were in England when the war first broke out will appreciate far more than can those who remained at home, the enormous value of having a large merchant marine immediately available for transport and other service. Of course, the regular service of passengers and their baggage was interrupted, but this counted little, in comparison with the disadvantages of carrying for years a great unused

fleet of equal size, and the consequent commercial interruption was one which in any event would have occurred very largely as one of the results of the war.

The defense of our homes and our country is essentially different, however, from the defense of our foreign possessions or the protection of our commerce. Here our very liberties would be at stake and our entire population, instead of a small percentage, would be endangered. And if this larger percentage were sacrificed the smaller would follow, whereas if the smaller were lost for the time being the preservation of the larger would eventually care for the smaller. Adequate defense begins probably with the mining of our harbors and our shore defenses. These would prevent destructive attacks and landing. Behind these should be available for immediate use an armed force of moderate size and behind this a force capable of being quickly mustered and armed, of practically unlimited size in reference to our population. It is conceivable that the time may come when every one capable of bearing arms will be called upon for defensive action.

The operation of large and small guns in the fortifications and the planting and control of mines calls for a minimum force technically trained and capable of instructing others who in the event of emergency would be enrolled for their assistance. An organization should be maintained at all times sufficient to man our fortifications at a minimum and sufficient to instruct any numbers added for the adequate operation of the defenses, however long an offensive attack might continue.

While the effectiveness of the submarine has been more fully demonstrated than ever before, some question remains concerning its relative value. About mines, however, as an element of defense, no question can exist. We have yet to hear of the failure of any mined defense.

Another technically trained force maintained at a minimum and in constant service should be that necessary to operate a fleet of aerial craft of all the types which have been shown to be effective during the present hostilities. Some doubt may remain at the moment as to the effectiveness of aerial attacks upon fortified places, but no question would seem to exist concerning their indispensability as a means of reconnaissance and for guarding against an enemy's attacks from the air. It is perhaps no exaggeration to say that without aerial defense such a city as Paris could be wrecked by the bombs of an enemy dropped from flying machines. A permanent corps capable of immediate and effective action and of instructing others on a greatly broadened scale, should be in the constant service of the country.

Automobiles, for transportation and for carrying warfare directly into the lines of the enemy, are increasingly important as military factors. This is another field in which the country should have adequate reserves available for immediate use and producing capacities

which would insure a supply, full and adequate, on very short notice. The standing force devoted to this purpose need not be so large relatively as that for defense, but the technique should be understood and the means of quick development should be always at the disposal of those in charge of our government.

The manufacture of guns and explosives perhaps falls into two classes. For the normal needs of commerce and the government it might well be that to a large extent, if not entirely, these supplies could be obtained from private manufacturers. Their capacity for manufacture and delivery would be a factor in preparedness. Behind this capacity and supplementing it, the government should be at all times prepared to manufacture equipment and explosives. This capacity for manufacture could probably consist of instructors and machinery, with a minimum of those technically informed in the work—one of those national resources or reserves of no value in times of peace, but of paramount importance in the event of war.

It is essential that we have a commissary plant capable of providing full service to a minimum of from half a million to a million men. That is to say, the mobilization of that number of men should be accomplished with an equally rapid mobilization of equipment and supplies necessary for their shelter and food. Behind this we should know that we have plant-capacity for turning out added equipment as rapidly as men could be mobilized, so that at no time should even a single company of soldiers go into camp or into the field without adequate commissary always within reaching distance.

Equal precautions should be taken with regard to the sanitary side of camp and trench life. Materials required should be immediately available for a minimum force and all the essentials should be so well understood that adequate sanitary provision would be made for every group of men the moment they are mobilized and put into active service. Never again should we have the blot of Tampa or Montauk Point on our military activities.

Chemistry is playing a part in this war which was heretofore unsuspected. For years, even before the Spanish war, it has been understood that the machine and the engineer would be great factors in modern warfare. But the chemist was given a place altogether too unimportant. All that is known in the use of and protection against poisonous gases or any other similar means of offensive action should be at the disposal of our authorities and all that the future may reveal should be placed immediately at their disposal. We should never go into action handicapped by a lack of knowledge concerning the offensive or defensive possibilities of explosives or chemicals or gases. Ignorance is no excuse for wounded, blinded or dead men, or for a defeat.

Individual equipment of each man for active service is another ele-

ment for which careful provision should be made. If we have a standing army of a quarter of a million men, its equipment would naturally be always at hand. And so for the additional army or armies which might be required to meet an enemy, equal equipment, individually complete, should now be provided. If we think a million men should be ready on short call for adequate defense, we should have a million complete equipments ready for instantaneous use for man and horse. In being thus prepared, we would be saved such pathetic sights as young men in civilian clothes marching up and down the streets of London or drilling in squads in the public places and parks, in their civilian clothes, carrying wooden sticks, to imitate guns, and other articles bound together to represent about the average load of a marching soldier. A minimum equipment should be immediately available and the means for providing enough additional equipment as men are assembled should be always at the service of the government.

Behind all this lies the preparation of the human machine, which to any needed extent should be capable of immediate assembly. The problem is how this is to be attained without turning our country into an armed camp or leading us to a distinctly military existence. The only way to secure this result would seem to be through the education of our older boys and our young men, say, between the ages of fourteen and twenty, in the elementary features of military life. These should include shooting and a knowledge of handling small arms; of marching and of living in camps and in trenches; of so approaching and retreating from an enemy as to make the most of either artificial objects—such as “digging in”—or natural objects for self-defense; of camp and trench life, including cooking and the elementary features of camp sanitation. The objective of this training would be to have the vast and growing body of men, who, with little more training than that necessary to fit them for the open, would be immediately available for any protective effort against the attacks of an enemy.

It would seem that this training must be conducted in such a way that it will reach every growing boy and will place at his disposal every means of acquiring this kind of information now at the disposal of our state and national governments. The present method of training state militia, whereby men can enter the regiments only by some form of social selection, and there remain year after year long after their periods of usefulness have expired, is obsolete and calls for early discardment. As a substitute, our armories should be open to all, exactly as our schools are open to all, and their use to any one individual should be limited to a certain period of time, say, one, two or three years, within which the necessary military training could be obtained. If it were two years, the second term men would be available for military service; or if

for three years, the third term men, supplemented by the second or first year men, in the event of emergency, as the circumstances might justify.

Probably the men who have seen even the smallest part of camp life or military service are the best safeguards we have against war. Those who merely observed the results of the early days of the war in Europe would do all that lies in their power to prevent a repetition of the European conditions in our own country. If this be true, this form of training, added to the hardships of camp life and military service, would seem to act as a deterrent and not an incentive towards war.

Military training leads to better physique and better physical condition; it adds a degree of discipline, which many observers think would improve our American standards; it is a desirable kind of education; it improves personal hygiene; it undoubtedly leads to higher standards of health and of living.

The subject is one which should be approached calmly and without hysteria. The lessons of the Spanish war and the conditions prevailing in Europe, however, warn us that adequate defense preparation is essential and that no time should be lost. Those who represent our government should take the country into its confidence, they should proceed broadly and, in this, eliminating all politics, may expect the unanimous backing and support of the country.

We must have a plan which will include a knowledge of what we have got, of what we can get, to what extent and in what time. It must include technical organizations, each complete with a minimum of equipment and trained men. It should include the best possible combination of government and privately owned resources for all purposes, from an adequate fleet of both a primary and a secondary nature to the provision of munitions, and equipment in any required extent. Distinction is made between an active and a latent producing capacity; the two should be separately considered, the plan of each effectively accomplishing its intended objective. And, finally, whatever may be the method adopted, we must have an unlimited citizen-reserve capable of getting quickly on the firing line, and behind this a reserve backing up those on the firing line without delay with every detail perfected of efficient and modern supplies.

Perfection of such a plan and organization would prevent rather than encourage us in seeking differences with other nations and would give us that degree of preparedness which is called for in the defense of our country, our institutions and our homes and the lives of our women, our children and our non-combatants.

## PREPAREDNESS

BY THE HONORABLE JOHN Q. TILSON

HOUSE OF REPRESENTATIVES

IN view of the fact that I am a member of the Committee on Military Affairs of the House of Representatives, which is charged with the duty of investigating the subject and formulating a plan for the proper organization of the land forces of the United States, it will not be wise or discreet for me to attempt to state just what the plan should be. It has been announced that the question is to be considered on non-partisan lines, as such subjects ought always to be considered, and this is an additional reason why I should not attempt to prejudge the case. There are, however, a few broad, general propositions which must be at the basis of any effective and permanent preparation.

In the first place, there must be a sufficient number of trained men to fill up our first line of defense. Their training need not be of long duration, but should be intensive enough to teach discipline, the use of firearms and the care of self in camp or campaign. It is better that these men be trained citizenry, rather than trained soldiers only. There is no more reason to fear militarism because of this than there is to fear that a boy will become a prize fighter because he keeps a sound body and is taught the manly art of self-defense. Some such system as that so successfully used in Switzerland and Australia would be effective here if it could be adopted and maintained long enough to get results. We must not be blinded, however, to the inherent difficulties in the way of the adoption or carrying out of such a system. Something, however, should be done and if the people of the United States are not ready to adopt universal citizen service, then in addition to our regular army and National Guard both of which should be somewhat enlarged, we should have a voluntary, but paid, reserve.

I have said that our regular army should be somewhat enlarged. This is absolutely necessary and seems to be generally accepted as one of the changes sure to be made in the near future. Even as a school for military training, the army at present is not large enough, and, while I do not believe that a large standing army is necessary, and should be opposed to the enlargement of the army comparable to those of European countries, still I think a very considerable enlargement is wise and necessary.

The navy should, undoubtedly, be gradually increased and the lessons of the present war in Europe should be carefully studied and applied in the addition of submarine and other auxiliary craft. Aerial navigation has greatly changed modern warfare and must receive immediate attention in both the army and navy.

Better industrial organization is also one of the necessities of an

adequate national defense. In the development of our resources, every man has gone too much his own way, so that there has been no effective coordination of our industries with a view to national defense. Every manufacturing establishment, great or small, that can manufacture arms, war munitions or any kind of war equipment, or that can be readily adapted to such use, should be catalogued and organized. In fact tentative contracts might be prepared and entered into between the United States government and manufacturing establishments to be effective only in case of invasion, war or imminent danger thereof.

Transportation should be organized in the same way in all its branches, including our railroad companies, steamship lines, our motor industries, especially trucks, and even down to business wagons.

There is one other general matter that I hesitate to speak of because it is generally considered a partisan question, but, as an avowed protectionist, I do not believe that it should be a partisan question. This is adequate protection for American industries, especially those concerned with the production of materials necessary in time of war. The aniline dye situation at the present time is a case in point. Our country has deliberately adopted a policy disregarding this industry and has encouraged the dependence of this country upon foreign producers of these goods. We now find ourselves hampered in our textile industries and in some instances a complete demoralization of business for lack of dye stuffs has occurred. Worse than all is the fact that the most effective explosives are those made from the same materials, so that we are to-day in a state of complete dependence upon a foreign country for materials essential in case of war. True, we have an abundance of raw material, but it would require valuable time and large expense to develop the industry under war conditions.

These are but examples mentioned by way of suggestion, but they seem to point the way toward the most effective kind of preparation, either for or against war, as the case may be.

While the present struggle in Europe has brought the question to the attention of many who before had been indifferent, to my mind it has not changed the problem so far as the United States is concerned, except in the details.

During the sixty-second Congress, while serving my second term there, I gave considerable thought to the question of preparedness, although it was not known by that name at that time. I introduced a bill providing for the beginnings of a trained national reserve for our land forces and presented to the House of Representatives facts and data in support of it. At that time, however, such a proposition fell on deaf ears, and the only change that was made, and that over my strenuous opposition, was the adoption of the absurd seven-year enlistment period, which has proved an utter failure; so far as providing an adequate reserve is concerned.

I do not believe that the danger of war is any greater for the United States now than it was three years ago. Neither do I believe that our need for an adequate national defense is greater than then. We needed it then, we need it now, and shall continue to need it until we face the problem squarely and solve it. We can not afford to go on taking long chances, as in the past. I hope something worth while will be done while the people are interested.

There is, however, a great danger of plunging headlong into an extreme course. It would be easy for us to roll up an enormous national debt for a kind of preparedness that would prepare us for the moment only and leave behind a heritage of debt and dissatisfaction that would soon neutralize the effect of all our preparation. A well-laid plan, covering a period of years, capable of enlargement or possible curtailment, if changed circumstances should make it wise, is far more to be desired than huge expenditures, rashly made, for preparedness that would soon cease to be effective.

### AMERICAN EXTRAVAGANCE A NATIONAL PROBLEM

By EDWARD A. WOODS

PITTSBURGH, PA.

Great Nations and great Empires only live so long as they are thrifty; the moment they begin to waste or disperse their resources, the day of their end is at hand.

—Lord Rosebery.

**I**LL-GUARDED, great wealth is tempting. If recently and suddenly amassed, made from those tempted to appropriate it, through the loss of their own trade, it tempts more; but it is greatest of all if those possessing this wealth are known not to possess the sturdy strength to defend it.

Nor must this strength be measured exclusively by an army and navy. Back of these lies the moral, physical and financial strength of the people. Effeminate, extravagant, prodigal nations, even if civilized, large and rich, have ever been the prey of strong, sturdy, frugal ones. So the rich east was a prey to the semi-savage Mohammed hordes. So was wealthy, effeminate Byzantium to the rough northern crusaders. So was wealthy, luxurious Rome—the mistress of the world—to barbarian Goths and Vandals.

Britons were angry at Kipling's message from South Africa, trying to shame the people of Britain because:

Ye set your leisure before their toil, your lust above their need.  
When your strong men cheered in their millions, while your strip-  
lings went to the war.

and at his famous reproach to sporting England:

The flanneled fools at the wicket or the muddled oafs at the goals.

But Americans and Britons alike may read "The Islanders" with a different feeling to-day, when he speaks of:

Life so long untroubled, ye who inherit forget  
It was not made with the mountains, it is not one with the deep.  
Men, not gods, devised it. Men, not gods, must keep.

Parkman, in closing his wonderful history of the French and English conquest of America, says:

Those who in the weakness of their dissensions needed help from England against the savage on their borders have become a nation that may defy every foe but that most dangerous of all foes, herself, destined to a majestic future if she will shun the excess and perversion of the principles that made her great; prate less about the enemies of the past and strive more against the enemies of the present, resist the mob and the demagogue as she resisted Parliament and King; rally her powers from the race for gold and the delirium of prosperity to make firm the foundations on which that prosperity rests; and turn some fair proportion of her vast mental forces to other objects than material progress and the game of party politics. She has tamed the savage continent, peopled the solitude, gathered wealth untold, waxed potent, imposing, redoubtable; and now it remains for her to prove, if she can, that the rule of the masses is consistent with the highest growth of the individual; that democracy can give the world a civilization as mature and pregnant, ideas as energetic and vitalizing, and types of manhood as lofty and strong as any of the systems which it boasts to supplant.

Wastefulness, extravagance and prodigality undermine the entire mental, physical, financial and moral fiber of the nation. Do they tend to make America such a nation as those New England farmers who resisted strong and wealthy Great Britain nearly a century and a half ago? With nations, as with individuals, the period of wealth is generally a period of decay, of sloth, and of the weakening of moral fiber. Can America, possessing one fourth of the wealth of the world, feel that the mere possession of wealth brings security, instead of an opportunity to others? Is it not the frugality of sturdy little Switzerland that enables her to keep out of the maelstrom of war that envelops her on all sides? Would France not long ago have succumbed, had her people, instead of being thrifty and provident, practised the luxury and extravagance of the United States? Will it not be the thrifty, frugal people of Germany, France and England who in the long run stand back of and support their governments in the great conquest over-sea?

It surely needs no argument to any careful observer to show that great wealth, particularly if quickly acquired, does not make for character in the individual. With it come luxury, waste and extravagance, and these are not character-building but character-undermining qualities, making the one who acquires wealth, and still more his descendants, luxurious, effeminate and neither frugal nor industrious. The same

thing is true of nations, for nations are but aggregations of men. In a comparatively short time America, young as nations go, has acquired over \$188,000,000,000 of wealth, equal, if a few European countries are excepted, to the wealth of the rest of the world, and an income that in three years or less would equal the total wealth of any single European nation—indeed, our income alone probably exceeds the entire wealth of every nation in the world except five; a wealth equal to that of the whole British Empire and France combined. Can there be any question that with us as a nation, as with an individual under similar conditions, this wealth, if not properly used, is a national menace? Are we an exception to the history of nations, ancient or modern, where, as recently brought out by the great Italian historian Ferrero, the period of a nation's suddenly acquired wealth is the beginning of its deterioration and decay? The decline of the great Roman Empire began at a period when wealth poured in upon her from all sides. Professor Davis says of Rome at the beginning of the Empire:

The Romans were suddenly put to the severest test a nation can meet—the trial of prosperity. The twentieth century opens with America enduring the same ordeal and it remains to be seen whether we shall bear it better than did Rome.

Is it possible that we are an exception to the often-quoted statement that the accumulation of wealth and the decay of men go together and to undermine that bold peasantry that is the backbone of a nation?

Every well-managed corporation and every well-run government lays out a budget planning in advance for its expenditures for the year ahead. How would a budget made of expenditures of the American people look? We are a great Christian nation, and yet we spend a little over two weeks' candy bill in our total contributions to missions! We are a generous and charitable nation, taking care of our dependent classes—sick and otherwise—as no other nation does. Yet the \$140,000,000 we spend annually for charity of all kinds is a little over three-weeks' liquor bill! Indeed, if the report of Vice Commissions that New York, Chicago and Pittsburgh spend for commercialized vice \$100,000,000 is correct, it is likely that the entire amount spent for charity of all kinds in the United States is a very much less figure than we spend for prostitution. It is not very much more than the amount we spend for one of our games—golf. Education has reached a higher position in America than in any other country; and yet the total amount we spend for education is less than we spend for jewelry; not much more than twice what we are spending for moving picture shows, and not as much as we spend for amusements! Out of an income of some \$35,000,000,000, how do such national expenditures as the following appear, with regard to the comparative importance of different items:

Interest .....	\$3,000,000,000
Liquor .....	2,300,000,000
Saved .....	2,000,000,000
Tobacco .....	1,200,000,000
Amusements .....	1,000,000,000
Automobiles .....	1,000,000,000
Sickness and medicines .....	1,000,000,000
Losses by credit .....	900,000,000
Jewelry .....	800,000,000
Crime .....	600,000,000
War and pensions .....	450,000,000
Candy and confectionery .....	365,000,000
Fire losses (mostly preventable) .....	250,000,000
Charity .....	140,000,000
Missions .....	16,000,000

Note what we spend for interest. The downfall of the government of Egypt came when she found that she could borrow money. The downfall of many a wealthy individual has been from misuse of credit, which, as John D. Rockefeller said, "Rightly used, is one of the best business assets, but, abused, has caused the downfall of individuals and nations."

With wealth and credit comes the borrowing habit that permeates our entire nation. Instead of meeting expenses from income, as the frugal, thrifty man should, Americans borrow. The government, state, county, city, township, individual—everybody borrows from the future to spend in the present. It is so much easier to spend future expectations than to wait until we can supply our wants from income or past savings. We are paying probably as much for interest in this country as the total savings of Great Britain and France.

Why is it that this country ranks fifteenth in percentage of savings accounts to population?

Switzerland .....	595 per 1,000
Norway .....	468 " "
Denmark .....	436 " "
Belgium .....	412 " "
Sweden .....	409 " "
Japan .....	400 " "
France .....	368 " "
New Zealand .....	360 " "
Germany .....	356 " "
Holland .....	340 " "
England .....	320 " "
Australia .....	300 " "
Tasmania .....	280 " "
Italy .....	232 " "
United States .....	109 " "

Why is it, with three times the income, we are saving but \$2,000,000,000 yearly, no more than Great Britain, and only twice as much as France, with one sixth of our income; not even saving every year as much as we spend for liquor? Note the countries which head the list in number of savings bank accounts—Switzerland, Norway, Denmark, Sweden, Japan, Tasmania—countries not of great national wealth; yet the average savings bank deposits per depositor of Switzerland, Denmark and Norway exceed that of this country.

Why is it that a country of our wealth has nearly 1,000,000 dependent persons it is constantly caring for; that it has between 10,000,000 and 15,000,000 persons on the poverty line? Why is it that out of a hundred young men who start in life at age twenty-five, at the age of seventy-five, of the sixty-three who die sixty have left no estate and that only three persons of the living are not dependent upon their children, relatives or charity; and that 95 per cent. of the remainder who die will not leave sufficient means to defray funeral expenses, unless insured?

Why is it, with the huge income of this country, 90 per cent. of its population finish their lives insolvent; and that even one tenth of the population in our great cities are buried at the expense of charity? Should we be satisfied with our social conditions in moderately asking that when every one comes into the world solvent, 90 per cent. should go out even more penniless than they came in?

It takes no character to spend money. It has been said that any fool can make money, but it takes a wise man to keep it. James J. Hill has said:

*If you want to know whether you are destined to be a success or not, you can easily find out. The test is simple and is infallible. Are you able to save money? If not, drop out. You will lose. You may think not, but you will lose as sure as fate, for the seed of success is not in you.*

The late Booker T. Washington, a negro, shows his conception of thrift as character-building. It is, he said, "the ability to sacrifice to-day for to-morrow." And yet there are millions of persons in this country who do not even imitate the dog who buries his bone of to-day for to-morrow; the bee, the ant, or the squirrel, who lays by for the future. The most civilized nation in the world contains millions of persons who live as does the savage—merely from day to day. And further, there are millions—and those the ones who can least afford it—who do not even see the need of frugality and thrift; who make fun of a man like Rockefeller, because he is moderate and careful in his daily expenditures; who think it is creditable to be lavish in their expenditures beyond their means; \$60 a month clerks, who regard it manly to order a meal and take the best seats at the theater for their girls, that both know are beyond their means.

It is the thrifty and frugal who are the backbone of the nation. It is they who supply its funds. It is they upon whom rests its credit. It is they who are not dependent upon society. It is they who support all its institutions, particularly its charitable ones. It is they who are not haunted by the grim specter of want throughout their lives. It is they who are forming habits of self-sacrifice and providence.

And further, it is they who, as a rule, are the happy persons. Micawber can hardly be taken as a type of happiness. Thrift is not miserliness; it is not niggardliness; it is not unhappiness; it is not avarice. These adjectives do not fit men like Carnegie and Rockefeller. It is the thrifty who have enjoyment because they can afford it, and enjoyment unhaunted by the fear of want to-morrow. It is the thrifty who are happier in the present because not fearful of the future—the saving, frugal, insured classes of the country. It is the thrifty who can afford to give their time to public matters, because not tied down to the actual needs of the day. And further, it is the thrifty who, by habits of self-sacrifice and foresight and frugality, are building the character that made the nation great when it was young, and that alone can keep the nation great. A man, or a nation, is worth what he saves, not what he spends.

Nor must we be deluded by the examples of the beneficence of the owners of great wealth. This also was characteristic of Rome in her wealthiest and also her decadent days. The days of Cæsar and the emperors immediately following were days of prodigality, of extravagant living and of lavish public gifts, but also of political corruption, of demagogism and of the decline and decay of the real people of Rome, who constituted its strength. It was then that millionaires controlled the Roman senate; that slaves could be bought for about fifty cents, while \$40 a pound was paid for fish; and that banquets costing the equivalent of hundreds of thousands of dollars were common and when the wealthy bought public favor by munificent gifts with money easily acquired. What is the solution?

That Americans may realize the importance of frugality and thrift; realize that wealth, not rightly used, does not bring happiness, health or prosperity, personal or national; that we should more liberally patronize our great institutions for the systematic saving of money—the life insurance companies, the savings banks, the building and loan associations, our safe securities; that we should use money spent for less good purposes for the building of homes, so that it can not be said that 96 per cent. of the population of Manhattan Island are renters. We all should make budgets, even in one's mind, in which the proportion of the probable income for the following year is laid out in some proper proportion; we must realize that it is not the money spent for necessities, but what we save—plus what is spent for education, for

charity, for wholesome recreation—that measures our advancement. The income altogether spent for food, clothing, housing and operating expenses leaves one at the end of the year just where one started. It is only by the amount saved and used for such self-improvement as may be gained from education, wholesome books and magazines, healthy recreation, travel, amusement, charity and, more particularly, laid by for the future in savings banks, in safe investments, in life insurance, that one can advance.

No business institution can be well run without keeping an account of expenses. Yet how many Americans keep no personal record of how their money during the year is spent! How can one find the weak spots in one's disbursements unless a record be kept? How easy to remember the money given one's wife or even given away and forget the money that is gone in cigars, in dinners, and perhaps in some ways that one is glad to forget! How helpful it is to voluntarily bind oneself to some definite method of saving, such as life insurance, probably the greatest institution for systematic thrift, where one makes one definite financial plan, extending far into the future, putting one under voluntary compulsion to lay aside so much money at a stated time each year; to put so much of one's weekly or monthly income regularly into a safe savings bank; the purchase of a home on the amortized mortgage plan, under which the mortgage will be made not for an indefinite time, but be reduced monthly; to buy good securities, by a definite plan of payment.

It is a wholesome sign that the thrift movement, starting in Europe with the war, has extended to this country; that there is a general realization of the necessity of frugality throughout the entire land; that the American Bankers Association, educators, journals, the Y. M. C. A., as well as, of course, the life insurance companies, are awakening to the opportunity and duty of arousing the richest nation in the world, with the greatest income, to so fortify herself that she may be secure not only against the foreign foe, but the most insidious and the most dangerous of all foes—herself. Only by the exercise and the continued exercise of qualities that make a people great, can greatness be maintained:

No doubt but ye are the people—absolute, strong and wise;  
Whatever your heart has desired ye have not withheld from your  
eyes.  
On your own heads, in your own hands, the sin and the saving lies!

## THE PROGRESS OF SCIENCE

## MILITARY PREPAREDNESS

THERE is published in the present issue of the MONTHLY a series of papers on national defense and development presented before the Section of Social and Economic Science of the American Association for the Advancement of Science. It is not clear why one aspect of the subject was emphasized at the meeting, but it is doubtless desirable that the arguments for military preparedness should be represented in this journal, as well as the opposite point of view. An obvious difference exists between the eleven sections of the American Association devoted to the natural and exact sciences and the one devoted to the social and economic sciences. The former are in the main concerned with the discovery of truth, the latter in the main with the expression of opinion, and the same holds for the articles published in this journal. It would not indeed be desirable to include such diverse subjects in the same association and in the same journal, except for the fact that it is one of the most important of all objects to establish the scientific method in belief and in conduct.

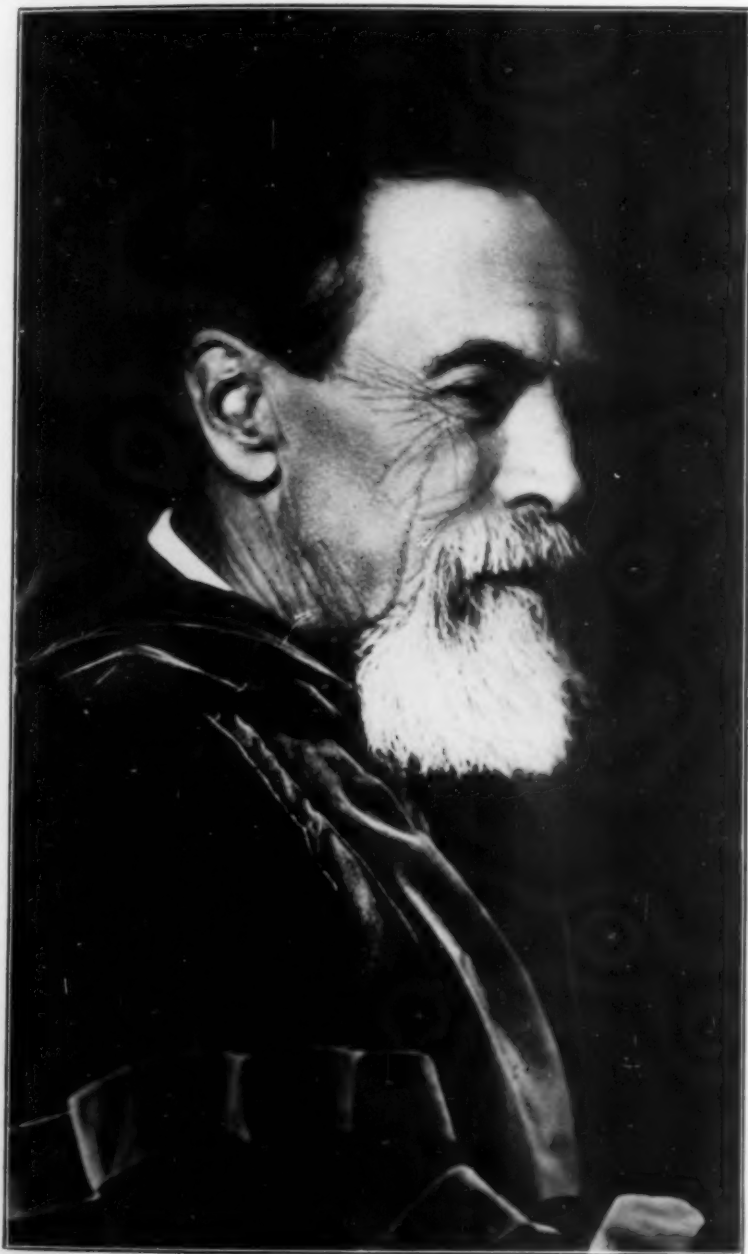
It is, however, particularly difficult to make any progress in this direction at a time when the emotions are deeply stirred. The people of each of the European nations now at war believe sincerely that they are defending their country and their homes against cruel enemies that have long laid in wait wantonly to attack them. The responsibility for the war and the methods by which it is conducted are judged absolutely differently by Americans of English descent living in Boston and by Americans of German descent living in Milwaukee. It is believed by

many that rivalry in armaments and in military and naval preparations intended for defense were the immediate cause of the present war and are likely to be the cause of future wars, yet nearly all the writers of the papers presented before the American Association and printed here argue that this country should increase its armaments and its military establishment in order to maintain peace.

The attempt of Germany to rival the British navy and the increased military preparations of Russia and of France may be regarded as at least among the causes leading to the present war. Nor is it evident that the efficiency for war of the different nations was proportional to their armaments. Their budgets in millions of dollars for the year just preceding the war were as follows:

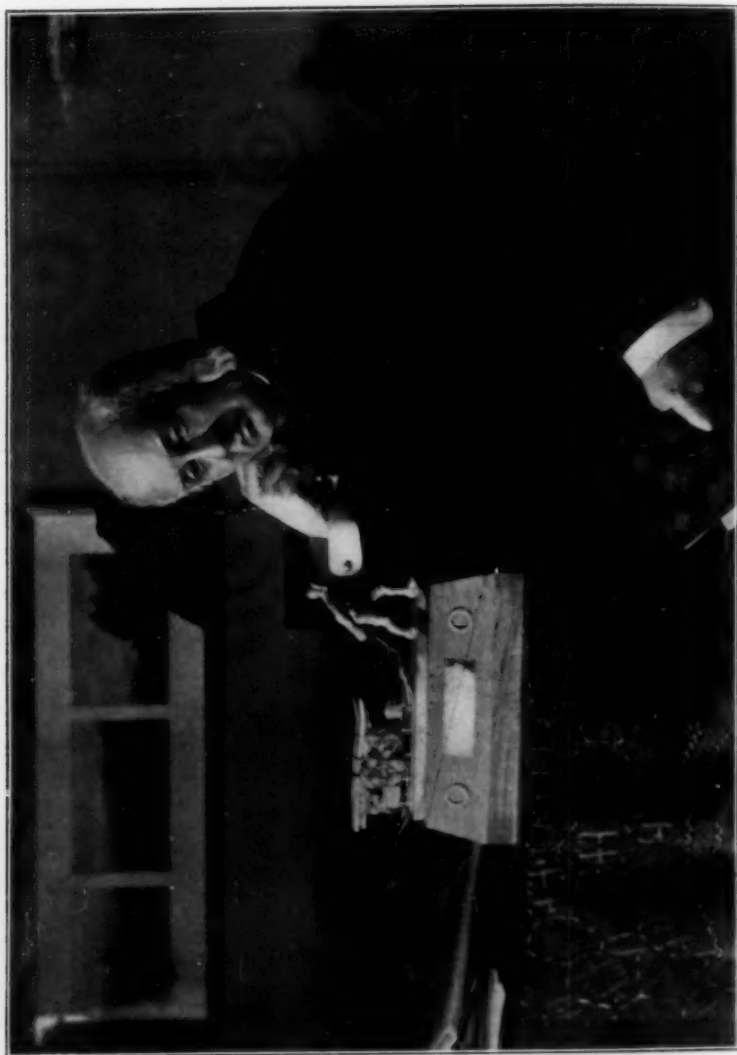
	Army	Navy
Great Britain .....	224,300	224,140
France .....	191,432	119,571
Russia .....	317,800	122,500
Italy .....	82,928	51,000
Germany .....	183,090	111,300
Austria-Hungary ..	82,300	42,000

Austria-Hungary and Italy about balance, as do also Turkey and Bulgaria, on the one side, and Servia, Belgium and the partial participation of Japan and Portugal, on the other. The expenditure of Great Britain, France and Russia on their armies was about four times that of Germany, but this does not measure their relative efficiency at the outbreak of the war. The militaristic spirit of Germany is in part due to the armaments of the nations surrounding it. A nation may pay for armaments which not only make war more likely but which may help the enemy when war comes. The strength of Germany was its educa-



EUGENE WOLDEMAR HILGARD,

Professor of agriculture in the University of California from 1875 until his retirement as professor emeritus in 1904, who has died at the age of eighty-three years.



SIR CLEMENTS ROBERT MARKHAM,  
Long president of the Royal Geographical Society, who has died in his eighty-sixth year.

tional, social and industrial organization; its disaster is its military preparedness, which gave power to the military caste and led them to make war when and as they thought it could be waged victoriously. The strength of Great Britain on the seas is in its commerce, of which dreadnaughts are merely a dangerous symbol. The strength of a nation, even when at war, is not in armaments that can be purchased, but in its people and their institutions.

#### SCIENCE AND NATIONAL STRENGTH

It might have been supposed that a discussion on national defense and development before the American Association for the Advancement of Science would have been concerned chiefly with emphasizing the importance of scientific education, scientific research and scientific organization as leading factors in the maintenance of peace and of national efficiency in case of war. If the battle of Waterloo was won on the playgrounds of the English public schools, it may be that other battles have been lost in the colleges of Oxford. At all events the complaint is made in England that its relative lack of success is due to its neglect of science. The classically trained dilettante, the political doctrinaire, the lawyer politician, the military martinet, are not fit leaders of a nation. The strength of this nation is in its engineers and physicians, in its scientific men, few though they are, in the great mass of the people engaged in productive agriculture and industry. We have shown what we can do in our railways, our automobiles, our telephones, what we can not do in our municipal and state governments, an admixture of success and failure in our schools and in our industrial organization.

A billion dollars spent, as is proposed, on the army and navy, as now organized, would be an incitement to

war and would only be of moderate use in a strictly defensive war. The armaments would soon become obsolete and other billions would be called for. A billion dollars spent on scientific education, on scientific research, on public health, or on public works, would be money invested in the way yielding the largest returns, and would accomplish more than armaments to make the nation strong in defense.

As the writer of this note urged before the war, we should have the best army for defense and improved police forces if all local police were soldiers, one twelfth of their wages being paid by the nation and one month annually being spent in camps and drills. Idling in barracks is a method for the promotion of war, drunkenness and disease. The engineering corps, the health service and the commissariat are the most important factors in modern warfare. Engineers, health officers, inspectors of food and others employed by the nation, the states and the municipalities should be at the same time officers in the army and those under them enlisted men. A well-organized and efficient army for defense would thus be maintained at comparatively small expense and be an institution for education instead of for demoralization.

The navy should be converted into a merchant marine, carrying a postal, express, freight and passenger service to every port in the world. At the cost of an idle navy five to ten times as many ships and men could be maintained and employed in useful work. In case of war swift ships and experienced men would win over dreadnaughts. Shipyards and factories for armaments and ammunition should be owned by the nation and manned by officers and enlisted men. The army and the navy can be made self-supporting nearly as easily as the postoffice.

If we had for the past three years employed a large force of men on the Mexican border to build railways and roads, irrigation dams and other public

works, it would probably have been a good investment. The net cost would certainly have been less than maintaining there an idle army, and our neighbors would have learned from us the ways of industry and peace instead of being irritated by an apparent threat. There would probably have been no raid; if it had been necessary for us to punish raiders it could have been done more effectively and with less friction than by the army as at present organized.

It might well be wished that instead of listening to Mr. Wise Wood and other frightened gentlemen, it were possible for the American Association for the Advancement of Science to use its influence to teach the president, the congress and the people that education, scientific research and the applications of science in agriculture and in industry, in the promotion of health and the prevention of waste and vice, are the ways to develop the greatness of a nation, to make it potent in maintaining peace, unconquerable in a war of defense.

#### SCIENTIFIC ITEMS

WE record with regret the death of Ivan Pavlov, the eminent Russian physiologist; of Sir William Turner, prin-

cipal of Edinburgh University, distinguished as an anatomist, and of Dr. J. Wilhelm Richard Dedekind, the German mathematician.

THE Hébert Prize of the Paris Academy of Sciences has been awarded to Professor M. I. Pupin, of Columbia University, for his theoretical and experimental researches in electricity.—The William H. Nichols medal has been presented to Dr. Claud S. Hudson by the New York section of the American Chemical Society.—The Albert medal of the Royal Society of Arts has been presented to Sir J. J. Thomson, "for his researches in chemistry and physics and their application to the advancement of arts, manufactures and commerce."

THE forty-fifth anniversary of its establishment was celebrated on February 9 by the United States Bureau of Fisheries, with the unveiling of a tablet in memory of its founder, Spencer Fullerton Baird, presented by his associates and followers. The bronze tablet bears a basrelief of Professor Baird with the inscription: He devoted his life to the public service and through the application of science to fish culture and the fisheries gave his country world-wide distinction.